FEBRUARY 1956

Power Engineering

Woodruff Dam Builders Try New Ideas With Standard Equipment 61
Insulation Specs Pay at Cromby Station 62
Return Lines Failing? Identify Cause Before Prescribing Treatment 66
Bad Ductwork Can Spoil Fan Performance 70
The Coolie Has to Be Materialistic 72
New Filter for Ordinary Air 73
Your Customers Deserve a Good Power Plant Open House 74
How Much Reactance Do You Need for Safe Short Circuit? 79
How to Write a Final Construction Report 80
Glass Block Walls Give Maintenance-Free Daylight 83
This Is the Way You Pull a Generator Rotor—II 84
What's the Best Way to Blow Out Turbine Main Steam Lines? 87
Automatic 24-Hr Effluent Sampler Is Simple, Easy to Make 89
Reducing Power Plant Maintenance Costs 90
Pre-cast Stacks Can Handle All Fuels, High Temperatures 91
Steam Trapping—Installation, Maintenance, Trouble Shooting 92
Here Are Ways of Improving a Laundry Heat Balance 94

REGULAR DEPARTMENTS

Engineers' Preview 3
Letters to the Editors 4
What They Tell Us 6
Helpful Bulletins 23
Construction News 44
Equipment News 48
News Reel 68
Power Engineering Handbook 96
Catalog Library 115
Readers' Service Post Cards 115
Index to Advertisers 130
Circulation of This Issue 37,060

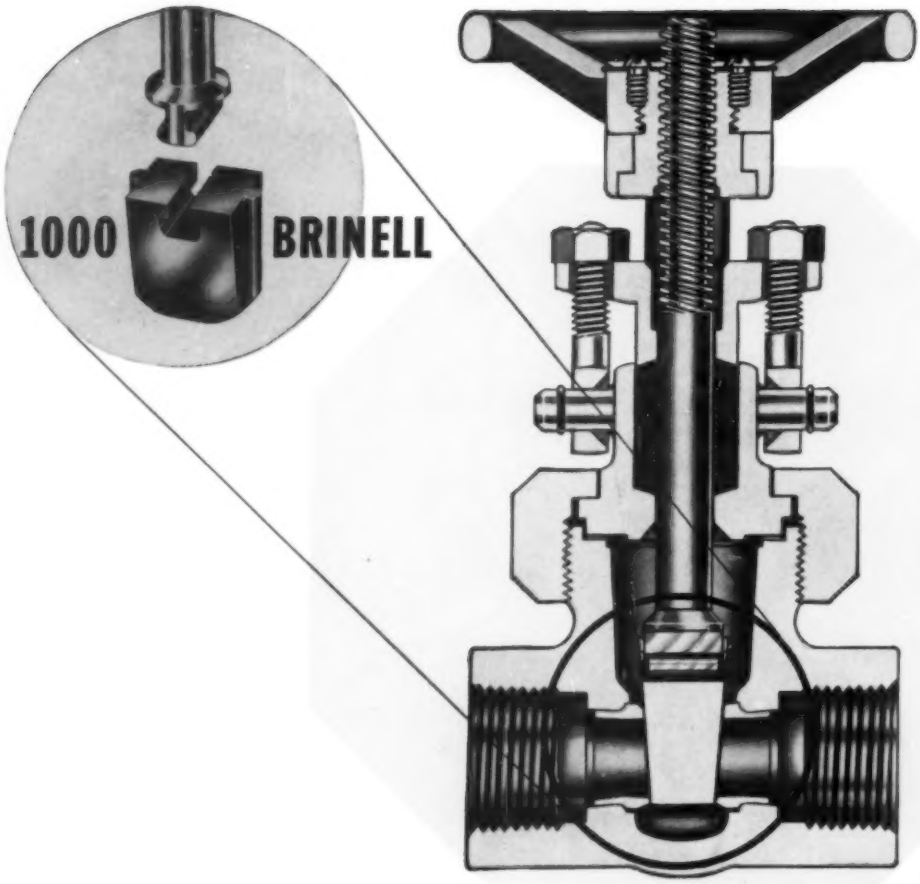

Fig. 1221

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Here's a wedge as hard as flint . . . so hard that it's undamaged by pipe cuttings, scale or grit. It's the only trim we know of which will successfully withstand the simultaneous attack of the three valve-destroying agents—corrosion, erosion, galling. This wedge is *13% chrome stainless steel hardened up to 1000 Brinell.*

Specify the OIC 1221 gate or 1621 globe where you need the extra rugged nature of forged steel. They are recommended for steam service up to 800°F...oil service up to 1000°F. Or, use these same valves for hydraulic service up to 2000 lbs.

Write for Form 195 for specifications on the OIC forged steel line.

THE OHIO INJECTOR COMPANY
WADSWORTH, OHIO

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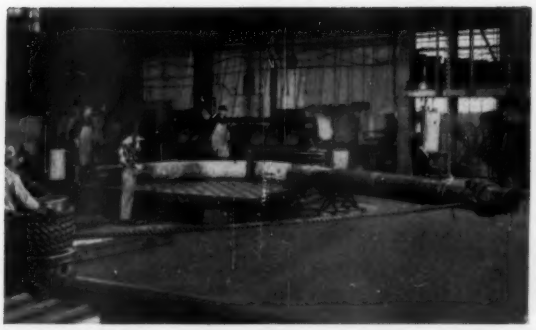
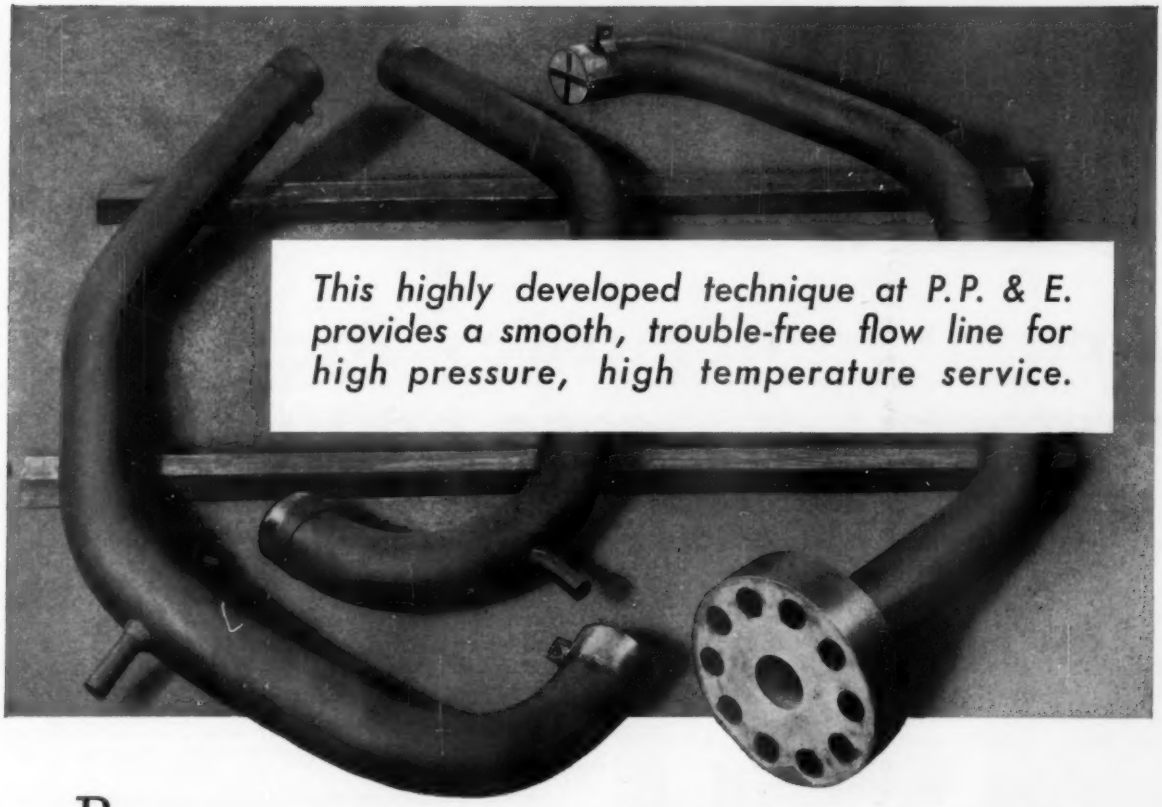
Hot Bending at Pittsburgh Piping





This highly developed technique at P.P. & E. provides a smooth, trouble-free flow line for high pressure, high temperature service.

Bending heavy wall piping is an art which provides a pipe line having best flow characteristics, with turbulence held to a minimum.

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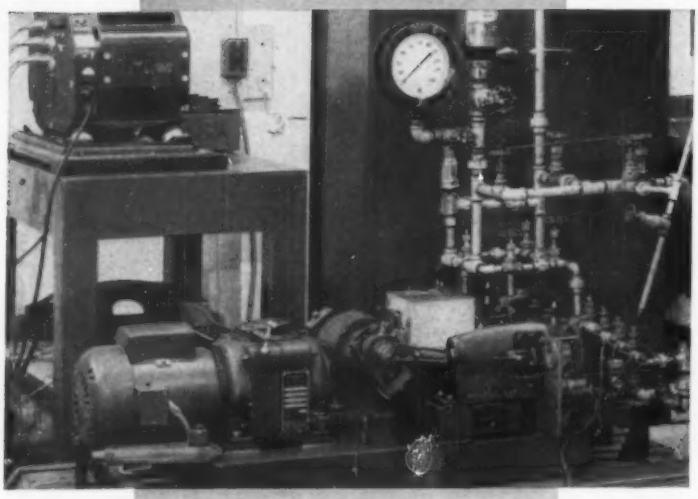
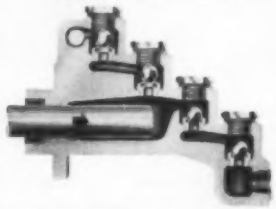


Standard motor-driven Controlled Volume Pump being tested for accuracy by independent research organization. *For details of test procedures and results, write for Technical Paper No. 55-1-1.*

Required accuracy for metering process additives

Exclusive Milton Roy
STEP-VALVE LIQUID END



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Engineering Representatives in the United States, Canada, Mexico, Europe, Asia, South America and Africa.

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PUBLISHED SINCE 1896 FOR POWER ENGINEERS IN PRIVATE AND PUBLIC UTILITIES AND INDUSTRIAL PLANTS

ENGINEERS' PREVIEW

NATIONAL Association of Power Engineers has arranged with the University of Wisconsin to conduct a series of correspondence courses in power engineering for its members. Anyone in the engineering or allied fields wishing information on how to take advantage of this educational program can apply to J. D. Holmes, Chairman of the National Educational Committee, N.A.P.E., c/o Magnus Chemical Co., Inc., Garwood, N. J. or to any Chapter of the Association.

. . .

TESTS COMPLETED by the Naval Research Laboratory in Washington have revealed that a new silver-zinc storage battery, used in the Viking 12 rocket, operated perfectly after falling to earth from a height of 143.4 miles, a distance beyond the earth's atmosphere.

Retrieved from the wreckage of the rocket in the desert at White Sands, New Mexico, the battery was put under test by the Navy in Washington. Not only did it perform perfectly but is in use today as a source of electrical energy for other tests now in progress.

. . .

SATISFACTORY PROGRESS is being made in a drive to raise funds for research into the properties of steam, according to James W. Parker, consulting engineer of Ann Arbor, Mich., and retired president of The Detroit Edison Co.

Mr. Parker, who is chairman of the Research Committee on Properties of Steam of The American Society of Mechanical Engineers, adds that contributions are still being solicited.

The proposed research project is of especial importance to persons in the fields of electric power generation, metals processing, food processing, ship propulsion, chemicals, petroleum, and atomic energy. Its main purpose is to provide data for extension of present steam tables to 1500 F and 15,000 psi. It would supplement the research that led to establishment of the International Skeleton Steam Table of 1934, which stopped at 1032 F and 5000 psi.

These limits have been exceeded in actual practice. The present need is for accurate information to confirm data achieved by extrapolation of the 1934 figures.

The committee headed by Mr. Parker is seeking contributions from American industry to foster research at an annual rate of $125,000 for three or four years, or $375,000 to $500,000 in all. Interested persons should write to P. H. Knowlton, Jr., chairman ASME Technical Committee on Properties of Steam, 29 W. 39th St, New York 18, N. Y.

. . .

HERBERT B. ADDINGTON, successor to Myers & Addington, consultants on steam and power, has moved his office from New York City to Pleasantville, N. Y. in the metropolitan area. His address is now P. O. Box 85, Pleasantville, N. Y.

. . .

"WARMING UP" of the world's climate may be due to mankind "contaminating the earth's atmosphere faster than nature can clean it," according to Dr. John G. Hutton of GE's general engineering laboratory in Schenectady, N. Y. He said the man-made boost in the carbon dioxide belt circling the planet may be having a greenhouse effect on climate.

. . .

AMERICAN COMPANIES now can keep abreast of European technological developments at less than the cost of one good researcher. The unique service is being offered by Armour Research Foundation of Illinois Institute of Technology, Chicago, to a group of 16 noncompeting firms. Under the program, the Foundation will set up an European office to funnel ideas and techniques of potential value in the American market to the participating companies. The program will be known as European Technical Observation Group.

Gas Turbine Primer Booklet Available

REPRINTS of the new training aid, The Gas Turbine Primer, are now available for 15 cents per copy, singly or in quantity. No mathematics are used in this 36-page booklet while discussing types of gas turbines, theory of their operation, details of construction and operation, and applications.

Originally published as part of the POWER ENGINEERING Handbook (October, November, December 1955), the material is intended for training operators and refreshing memories of engineers.

PRODUCTION of synthetic oil and gas will probably begin on a large scale within the next 10 years to supplement the dwindling resources of natural gas and oil. Coal will be main source for synthetic fuels; coal production must rise accordingly.

These are the main conclusions drawn in an article on the future of synthetic liquid and gaseous fuels appearing in the January issue of *Mechanical Engineering*. Joint authors are Howard B. Batchelder and Harlan W. Nelson, Battelle Memorial Institute. They base their conclusions on estimates of population growth, per capita consumption of fuel, and fuel supplies.

. . .

OHIO POWER CO. has announced it is acquiring 500 acres of land along the Ohio River just north of Clarington, Ohio, for the site of a future 1,000,000-kw steam-electric generating plant. Decision to purchase a site for a proposed plant near Clarington was the result of the increasing industrial growth in the area and the entire Ohio Valley region. The chances are excellent that construction will begin within the next two or three years because the Ohio Valley is in the midst of one of the greatest industrial expansion movements in the country. The Clarington site was especially attractive for a large electric power plant because of its proximity to abundant and economical coal reserves and the availability of river water for steam-condensing purposes.

NATIONAL winter convention of the American Society of Civil Engineers will be held in Dallas February 13–17 in the Baker Hotel. Attendance is expected to exceed 1,400, according to I. W. Santry, Jr., Associate Professor of Civil Engineering at Southern Methodist University, general chairman of the convention.

Some 80 technical papers will be presented. Meetings are scheduled for the Air Transport, Hydraulics, Structural, Waterways, Highway, Power, Sanitary Engineering, Surveying and Mapping, Soil Mechanics and Foundations, Irrigation and Drainage and Engineering Mechanics divisions. There will also be meetings of the Pipeline Committee of the Construction Division and the Department of Conditions of Practice. A symposium on the use of plastics as engineering materials will be one of the first comprehensive discussions on plastics to be held at an ASCE national meeting.

. . .

DR. JESSE E. HOBSON, director of Stanford Research Institute since March 1948, has submitted his resignation effective March 31.

In a letter to Dr. J. E. Wallace Sterling, president of Stanford University and chairman of the Institute's board of directors, Dr. Hobson said he had "made this difficult decision from necessary considerations of personal health and because of pressing problems that are immediately and personally important to me and my family. Although this action is taken in the best interests of my own welfare and that of my family, I submit my resignation with great reluctance and only after careful thought."

LETTERS TO THE EDITORS

Pumpless Dry Dock

CONSTRUCTION OF the St. Lawrence River–Great Lakes seaway project brings memories of a situation at Montreal which has been in existence some 50 years and will doubtless continue for an indefinite period.

The Lachine Canal, built to bypass the Lachine Rapids, passes through an active manufacturing section of the City of Montreal, and many of the industries use water from the Canal for their particular purpose. The water, coming as it does from Lake St. Louis, is fairly clear and does not require elaborate treatment before utilization.

The particular operation, as the title indicates, is one involving vessels passing through the Lachine Canal that are in general less than 5000 tons displacement. At a point located close to 2050 Notre Dame Street West, near Canning Street, the Canal is tapped and a sizeable watered area is made available for handling floating equipment. The Canal at this point, and the watered area, are at a higher level than Notre Dame West, so the docking and undocking procedures are greatly simplified and do not follow the methods followed at most seaports.

Actually, the vessel enters through an opening to the Canal, which is then plugged by a type of floating pontoon. A valve is then opened and the water runs off through the City sewer line and in a short time the watered area is dry.

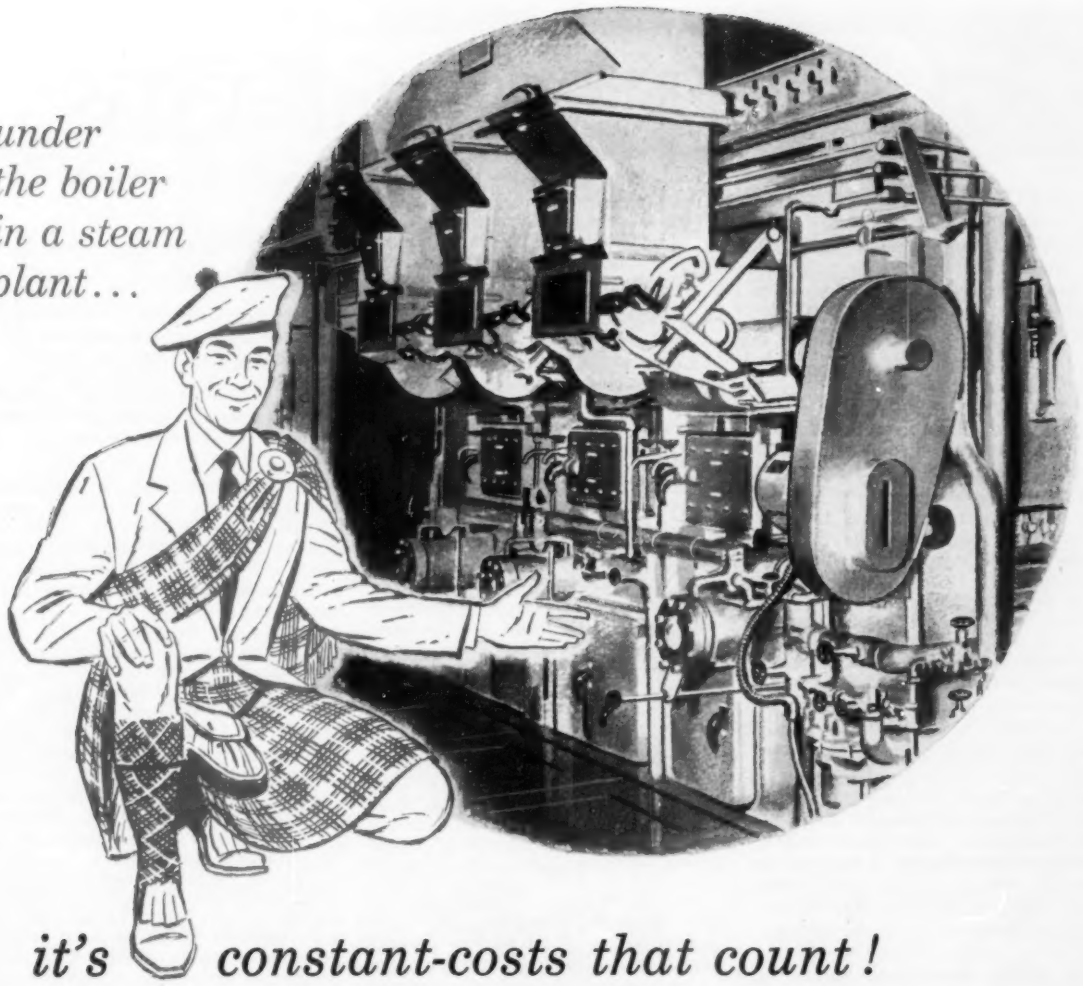
To fill the unwatered area water is obtained by opening, with a valve, a connection to the Canal. The area is soon filled, the pontoons removed, and the vessel can leave via the Canal. Actually the two men, according to this writer's observation, took care of the docking and undocking operations.

Sight-seeing vessels like the *Rapids Queen* and others which, during the open season, operated through the Lachine Rapids, as well as larger vessels, used these facilities, which were so readily available and could be handled so expeditiously. The present operator is St. Lawrence Dry Docks, Ltd.

It seems unlikely the Lachine Canal will be discontinued as a source of river water for an appreciable period for it is so closely involved with so many commercial operations on both banks.

There may be operations of a similar nature for this purpose, although the writer, brought up in a seaport area, has been unable to find any. With experiences limited to marine railways, floating dry docks and graving docks all requiring pumping or mechanical operating facilities, the operation described is simplification to the nth degree. — *Carl O. von Dannenberg, Brooklyn 38, N. Y.*

under the boiler in a steam plant...



it's constant-costs that count!

Be Thrifty! Expensive boiler installations designed to burn fuels with limited futures is doubtful wisdom. The sensible alternative is to *bank on Bituminous!* Plotting your costs over the long run will prove efficiency and lowest cost in most cases. For, Bituminous reserves are unlimited—they're nearest to most manufacturers—coal technology improves burning equipment, efficiency and cost year by year.

Let our Coal Technical Service plot a constant-low-cost Bituminous coal for your needs. *Ask our man!*

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BITUMINOUS COALS FOR EVERY PURPOSE

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WHAT THEY TELL US

ENGINEER C. P. ELIOT, associated with a public utility in the state of Washington, queried

> Can you inform us as to whom we should contact for more information on the "Zimmerman Process" described on page 63 of December 1955 POWER ENGINEERING?
>
> We have in mind a definite application which we should like to explore.

For direct contact, this information was given by one of our associate editors, but curiosity also prompted him to write Mr. Eliot

> I am naturally curious to know what you contemplate for this process. Would it by chance be a large-scale switch to "Disposal" handling of domestic garbage, with subsequent wet burning? This has occurred to some of the engineers with whom I discussed this process and it might be quite feasible.

A UTILITIES SUPERINTENDENT, with the U. S. Air Force, referred to Rapid Repairs with Reinforced Resin, published in December 1954. He asked if the resin could be used satisfactorily on a high-octane gasoline line.

The answer was "Yes, it could be."

RETURNING FROM the Nuclear Engineering and Science Congress at Cleveland, Ohio, December 11–16, Editor Kramer reported

> No one attending this meeting could fail to have been impressed by the tremendous size of the nuclear industry today. Over 350 technical papers and addresses were presented and these covered everything from the mining of fissionable deposits to the final problem of disposing of radioactive wastes.
>
> This Congress represented all the engineering societies — 26 of them — and was coördinated by the Joint Engineering Council. It was attended by the top engineers and scientists of public utility companies and manufacturing organizations, as well as personnel from the various AEC laboratories and many universities and colleges. A major feature was the International Atomic Exposition which was held in conjunction with the Congress.
>
> This exposition was said to be much larger than the one held at Geneva last summer, and despite a $2 admission charge, was attended by over 10,000 people the first two days. During the week, 25,000 people attended the exposition, and only 2,000 of these were general public.
>
> The Congress at Cleveland is only one manifestation reflecting the tremendous growth of the nuclear energy industry. While the industry covers everything from agriculture, medical and biological activities to the use of radiation techniques in the control of industrial processes, by far the largest segment of interest and development lies in the field of nuclear power.
>
> It is confidently expected that large reactor plants will become economic about 1962. By 1963, it is expected that more than 7½ billion dollars of private capital will have been invested in the United States on power reactor construction. In less than five years we will have over 500,000-kw of nuclear power capacity on the lines.
>
> From that time on nuclear power development will be very rapid.

THAT REMINDS US, if you didn't receive Editor Kramer's booklet entitled POWER ENGINEERING Keeps Pace with Progress and Changing Times for 3 Generations, write today for your copy. The booklet was presented to engineers attending the 75th Anniversary Meeting of the ASME in Chicago. It highlights the development of power from the early steam engine days to the present atomic power days, is well illustrated, and will give you some very pleasant and profitable reading.

MEMBERS of POWER ENGINEERING's Staff also wish to thank everyone for the thoughtful letters sent to them following the ASME Annual Meeting last November. We'd like to print all of them but there isn't enough space. However, we did snatch a few lines here and there:

> ". . . Your hospitality during the ASME National Convention was much appreciated. I just never have met a group of people who radiated such warmth and friendship."
>
> ". . . We spent many happy hours in POWER ENGINEERING's Suite in the company of Mr. and Mrs. Hagenmiller . . . It is little enough to merely say 'thank you' for this gracious hospitality. We have carried home from Chicago a wonderful impression of your city and its people."
>
> ". . . I want to thank everyone at POWER ENGINEERING for the friendship and kindness shown at the Convention."
>
> ". . . Please forgive my lateness in saying 'Thanks Again' for the wonderful hospitality shown us during the Convention. It was indeed a pleasure to meet so many charming people in your organization."
>
> ". . . I am sure all who visited your Suites will have gone home with happy memories of their stay in Chicago, thanks due in a large measure to POWER ENGINEERING."

IN A LETTER from Tennessee Paper Mills, Inc., W. F. Leydorf asked

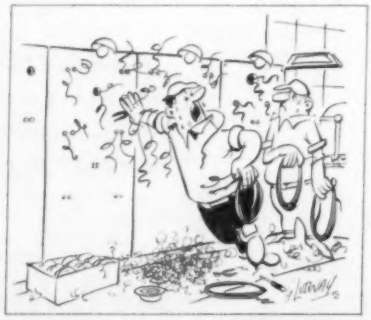
> Could you furnish us with information regarding the commercial uses of fly ash? We have on hand your issue of April 1954 containing the article, Who'll Buy My Fly Ash? but would appreciate any recent developments in marketing fly ash, such as standards, analysis, etc.

We sent tear sheets of our later article, Fly Ash Hits the Road, from October 1954. While this article is far from a complete treatise on fly ash handling, grading and marketing, it does go a short way into each of these questions.

One of our associate editors forwarded comments on a rather new development — the use of fly ash admixtures in oil well cements. He noted that all, or most of the fly ash production of Oak Creek plant of Wisconsin Electric is now going into this application; also that Detroit Edison is selling its ash to the Michigan State Highway Department when the carbon content is in the 7 to 12% range.

Carbon content is determined by firing samples at 1500 F and measuring the weight loss. The samples are collected with a "sample thief" from a pneumatic conveying line. This thief projects 3 inches into a 6-in. line on an angle and has a 0.025-in. slit cut into the stainless steel tip. The extracted ash represents a continuous sample, or average sample, and can be checked at random, or on a fixed schedule.

Detroit Edison Company checks on a daily and weekly basis, finding the average quality for each period. Their sales from Marysville plant amount to about $15,000 per year.



"Say! Whatever happened to atomic power?"

Hall Industrial Water Report

VOLUME 4 FEBRUARY 1956 NUMBER 1

New Plant or Expansion of Old One

How well you engineer your plant services may determine whether you get continuous production or operation like a paralytic centipede. Water for steam generation, for cooling, for use in process—and water leaving the new plant—*can* be designed to be the least of your troubles. But the best time to listen to someone who knows how to make water behave is while you are still in the planning stage.

It's Cold Out There!

Frequent subzero weather with temperatures as low as −45 at the site of a proposed new plant in Minnesota was an important factor in the choice of a heating system by a large mining company planning to process iron from taconite. Space heating constituted about ninety percent of the load. Buildings to be heated were widely scattered over a large area.

When a high-pressure hot-water heating system was decided upon, water treatment had to be considered from two angles: protection of the boilers and protection of the heating system. Hall Laboratories was invited to study the raw water available and to recommend treatment.

Water could be obtained from either of two intakes from the surface supply; samples from both were analyzed. The types of metal used in construction of the heating system were determined, zeolite softening and deaeration of makeup, chemical conditioning and proportional chemical feeding facilities were thoroughly discussed in a survey report by Jack Summerville, Hall staff engineer. After completion of the survey report, it was learned that well water might have to be used temporarily because of delay in completion of the surface supply pipe line. Because the well water does not have as desirable a composition as the surface water, Hall urged that the pipe line be completed as quickly as possible and recommended that the well water be zeolite softened even though regenerations would be much more frequent.

The boilers have now been boiled out and, on Hall's recommendation, acid cleaned to insure thorough cleanliness of the heater surfaces. The plant is beginning operation.

Water is your industry's most important raw material. Use it wisely.

Faith Justified By Performance

When an Eastern paper specialty manufacturer decided to build a new plant in California, the chief engineer wrote: "In dealing with the problem of water supply, water treatment, and so forth, we felt it desirable to call in Hall Laboratories, not only because of the past relations which have existed for so many years, but because we intend to retain Hall Laboratories as consultants for our California plant."

To start the survey, Hutcheson Page, of Hall's New York office, conferred with the plant management about the purchase of their boiler. After extensive checking of specific requirements, a factory-assembled, water-tube boiler was ordered.

Hall Laboratories already had experience with the water in the chosen locality in California. This provided a sound basis for recommending the proper pretreating equipment.

Because of the potential cost of water supplied from a city aqueduct, the plant wished to use water from its own wells. Hall recommended pretreatment equipment flexible enough so that it could properly prepare any of the various waters available for future use in any standard type of boiler operating at 250 psi. A salt regenerated cation-anion exchange system was suggested and accepted.

The plant also has followed other recommendations made by Hall for internal boiler-water treatment as well as treatment of steam by Hagamin.® A recent service report from Hall field engineer Orville Morrow states that the plant is maintaining very good treatment control.

South of the Border

Hall Laboratories pursues the "Good Neighbor" policy by helping many clients in South America and the West Indies on a consulting as well as on a continuing service basis.

A client in Maracaibo planned to install an additional boiler plant adjacent to the one already serviced by Hall Laboratories. Hall helped the plant select evaporator feedwater pretreating equipment, chemical feed pumps, pH meters, and helped plan the laboratory layout prior to start-up. Then Jack Summerville of the Hall headquarters staff made a trip to Maracaibo to help start operations, with special attention to their hot lime-gypsum reactor, pressure filters, hot zeolite softener, evaporators, and the treatment of their feedwater-condensate and boiler-water systems.

Continuing satisfactory conditions have been maintained by correspondence between the plant and Pittsburgh headquarters, supplemented by an annual consulting trip by Hall staff engineer, Alex Henricks.

Industrial Water Problems Require Special Handling

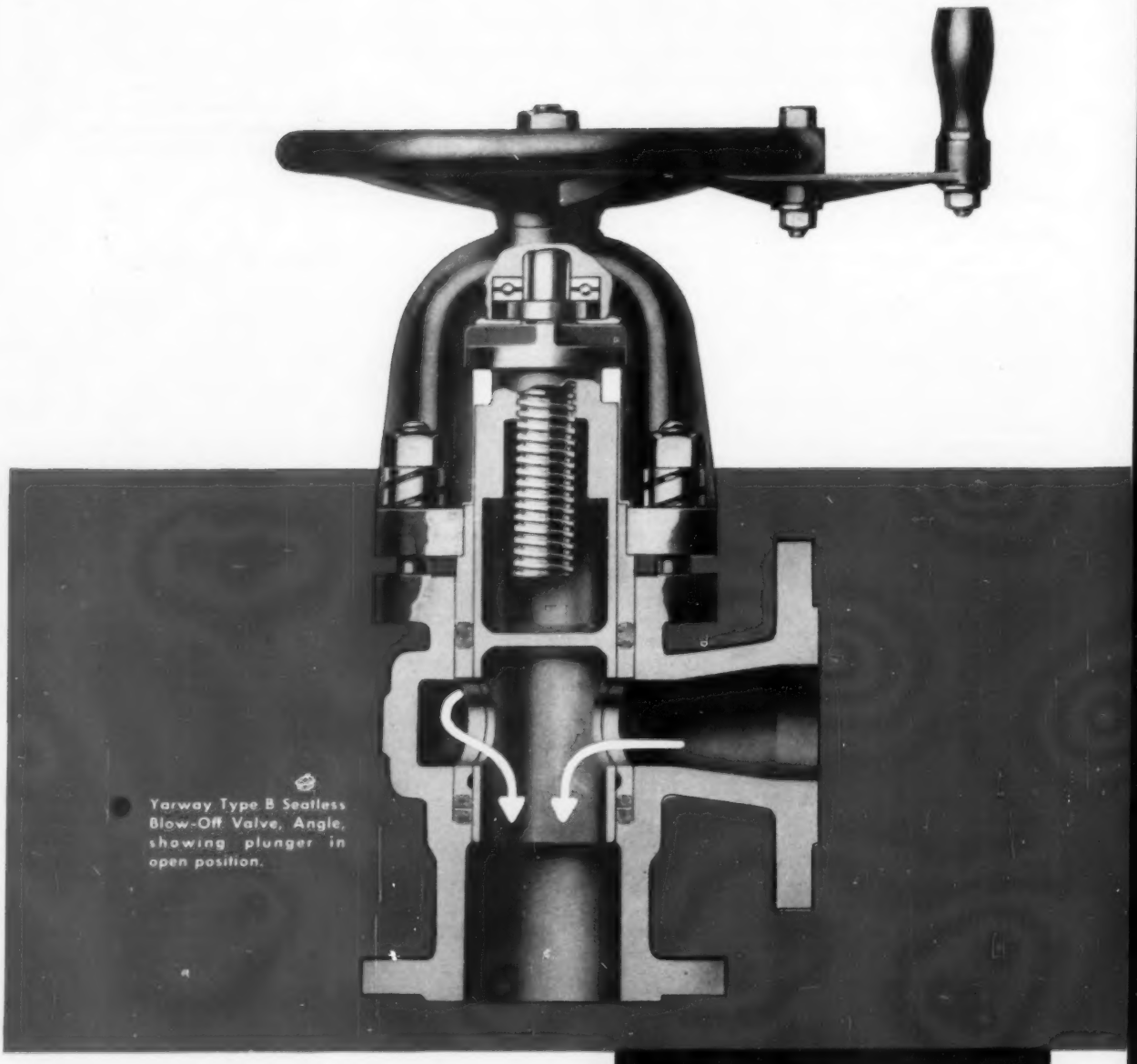
There are no "stock answers" to industrial water problems. For information write, wire or call Hall Laboratories, Inc., Hagan Building, Pittsburgh 30, Pa.

Hall Laboratories, Inc.—Consultants on Procurement, Treatment, Use and Disposal of Industrial Water

For more data circle 505 on Post Card

seatless

. . . for



Yarway Type B Seatless Blow-Off Valve, Angle, showing plunger in open position.

YARWAY

trouble-free blow-down service

YARWAY SEATLESS BLOW-OFF VALVES

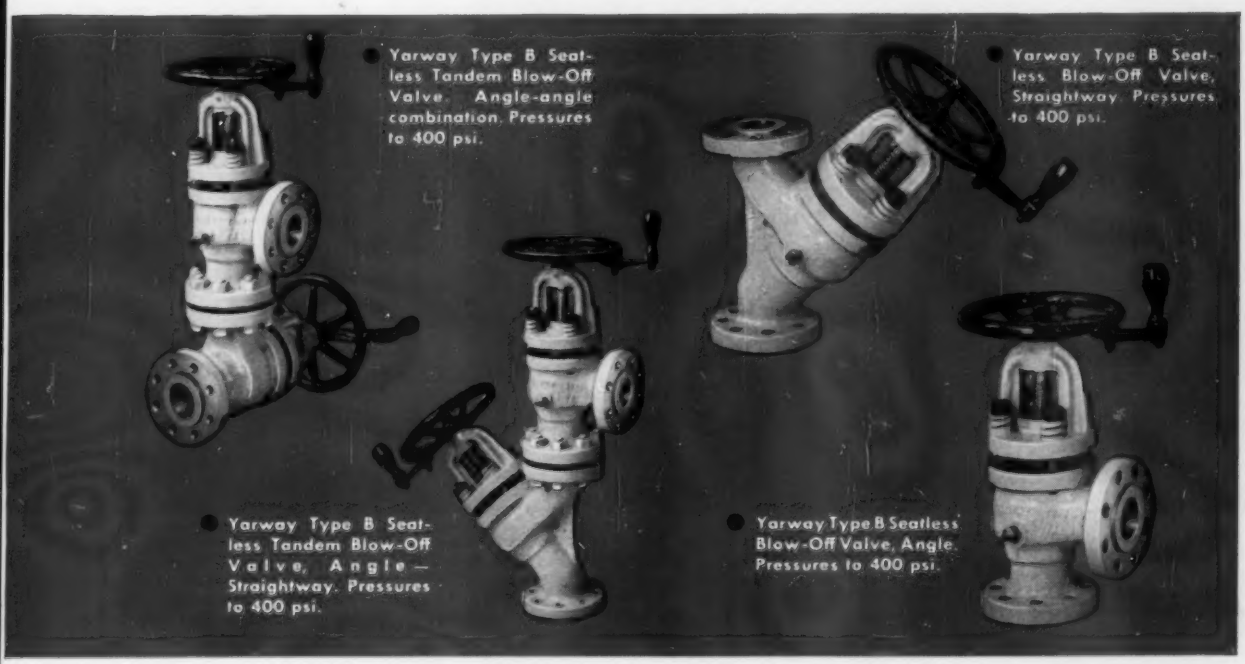
"Trouble preventers" is what YARWAY Seatless Blow-Off Valves are often called because they eliminate one of the commonest sources of trouble in low and medium pressure boiler blow-down service. *There is NO SEAT to score, wear, clog or leak.*

YARWAY Seatless Blow-Off Valves feature a balanced, sliding, hollow plunger design that permits free and easy operation—full, unobstructed flow.

More than 16,000 boiler plants today use YARWAY *Blow-Off Valves.*

YARWAY Bulletin B-426 shows all the latest types and features of YARWAY Seatless Blow-Off Valves. If you operate your boilers up to 400 psi, you'll find a copy helpful. For higher pressures, ask for Bulletin B-434. Write today.

YARNALL-WARING COMPANY
100 Mermaid Ave., Philadelphia 18, Pa.
BRANCH OFFICES IN PRINCIPAL CITIES


Yarway Type B Seatless Tandem Blow-Off Valve. Angle-angle combination. Pressures to 400 psi.
Yarway Type B Seatless Blow-Off Valve, Straightway. Pressures to 400 psi.
Yarway Type B Seatless Tandem Blow-Off Valve, Angle—Straightway. Pressures to 400 psi.
Yarway Type B Seatless Blow-Off Valve, Angle. Pressures to 400 psi.

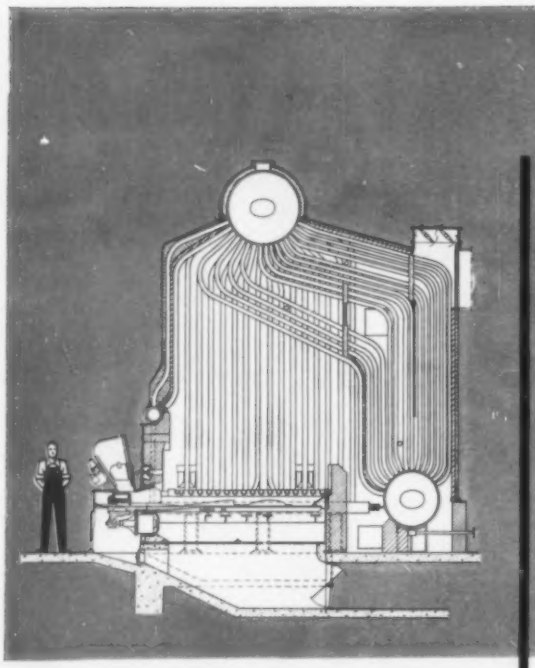
— blow-off valves

For more data circle 506 on Post Card

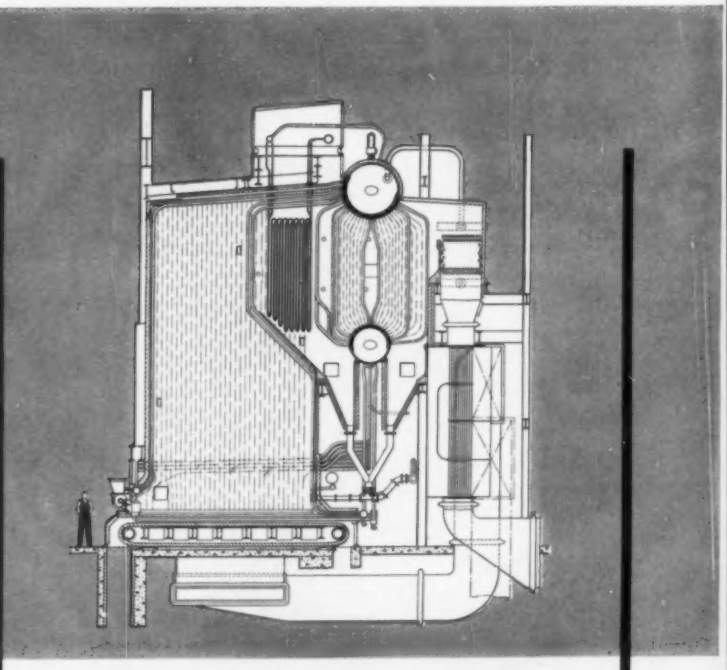
MODERN STOKER-FIRED BOILERS

Despite the relatively wide extent to which oil – and gas – have come into use for firing industrial boilers, the fact remains that coal continues to be the most economical fuel available in many areas.

Moreover many potential coal users are unaware of the tremendous improvements that have been made in recent years in the design and general effectiveness of mechanical stokers. Here at Combustion virtually the entire stoker line has had extensive design changes, all directed at improved performance. But overall performance is tied in inescapably with boiler performance. At Combustion you have the important advantage of dealing with a leading boiler manufacturer that also offers the most complete line of stokers available anywhere. You are assured, therefore, of a completely coordinated design comprising



This C-E Vertical-Unit Boiler, Type VU-10 fired by a C-E Underfeed Stoker, Type E is for a dairy. Capacity is 30,000 lb steam per hr at 150 psig. VU-10 Boilers are available for capacities from 10,000 to 60,000 lb of steam per hr. They are often equipped with C-E Spreader Stokers, dump grate type.



One of two duplicate units for a chemical company comprising C-E Vertical-Unit Boilers, Type VU-40 fired by C-E Spreader Stokers, continuous discharge type. These are baffleless boilers designed for a capacity of 150,000 lb steam per hr at 900 psig and 808 F. Coal is Eastern Bituminous.

COMBUSTION

Combustion Engineering Building, 200 Madison Avenue, New York 16, N. Y.

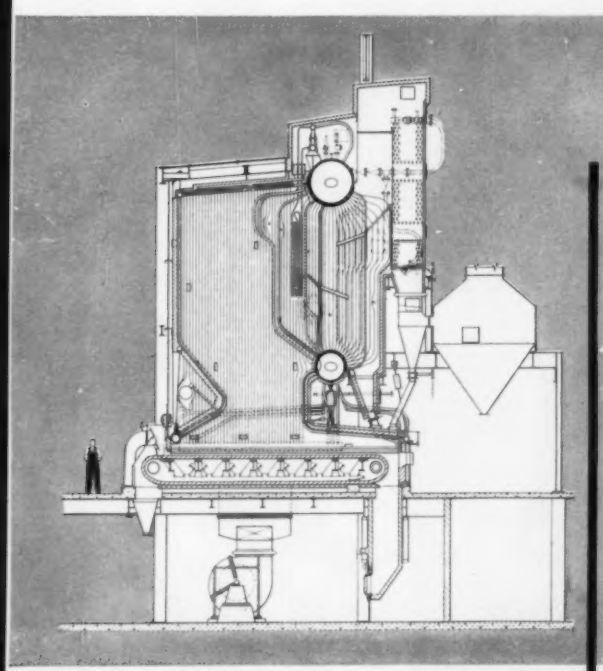
STEAM GENERATING UNITS; NUCLEAR REACTORS; PAPER MILL EQUIPMENT; PULVERIZERS;

stoker, boiler, furnace and – if desired – heat recovery equipment and/or auxiliaries, all engineered specifically for your particular requirements.

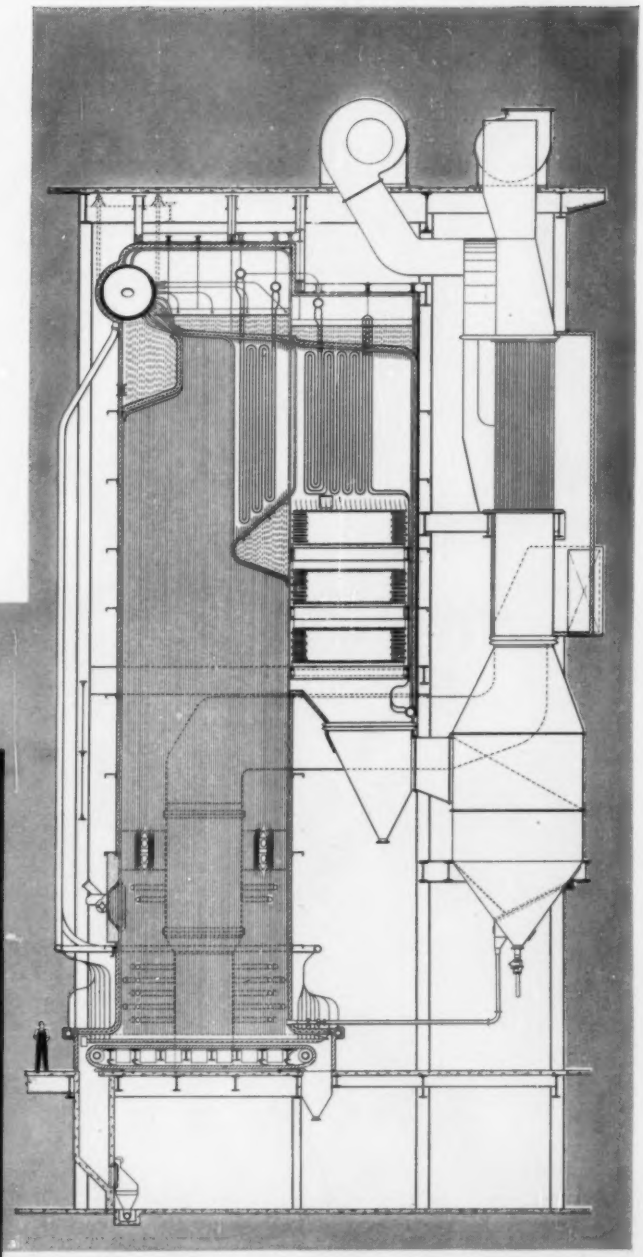
Displayed below are three – of the many – C-E stoker-fired boiler designs which, collectively, are suitable for any coal-firing conditions.

At the right is illustrated the latest – and largest – example of the C-E Bark-burning Unit, a design pioneered by Combustion and now widely used for burning bark, hogged-wood and other waste wood fuels.

So – when you are in the market for coal or other solid-fuel-burning units it will certainly be to your advantage to find out what Combustion Engineering has to offer. Our engineers will be glad to discuss your needs with you or your consultants. B-892



This C-E Unit is being installed for a soap company. It comprises a C-E Vertical-Unit Boiler, Type VU-50 fired by a C-E Traveling Grate Stoker. Coal used is Midwest Bituminous. This boiler is designed for a capacity of 100,000 lb steam per hr at 850 psig and 585 F. It is an outdoor type unit.



C-E Bark-Burning Unit for a paper company. This is a very large unit; capacity – 450,000 lb steam per hr, operating pressure – 1335 psig; total steam temperature – 958 F. It is designed to burn bark, natural gas, oil or any combination thereof. C-E Bark-Burning Boilers are in service for capacities as low as 20,000 lb of steam per hr.

ENGINEERING

CANADA: COMBUSTION ENGINEERING-SUPERHEATER LTD.

FLASH DRYING SYSTEMS; PRESSURE VESSELS; DOMESTIC WATER HEATERS; SOIL PIPE

For more data circle 507 on Post Card

TYPE CV-D
TYPE CV-P
COPES-VULCAN

Announcing... the new

COPES-VULCAN VALVES

. . . with new versatility
. . . with new broader application
. . . with new attractive appearance

THE NEW HIGH-QUALITY Copes-Vulcan valves offer simplified designs and can handle any application at unlimited pressures for pipe sizes up to 16-inch. They have all the rugged dependability typical of Copes-Vulcan products. As always, they will be custom-designed with ports exactly suited to individual operating conditions.

NEW VERSATILITY IN DIAPHRAGM-TYPE, CV-D

You can now assure yourself of unsurpassed Copes-Vulcan quality in valves for operation at unlimited pressures. You may have either direct or reverse action. Rangeability is high.

Optional features include: Cooling fins and lubricator for stuffing box that will maintain low friction over a longer packing life . . . a top or side-mounted hand wheel to permit emergency operation . . . Auto-lock to hold the valve in its last position, should control air fail.

NEW SIMPLICITY IN PISTON-TYPE, CV-P

This is the high-duty Copes-Vulcan valve—simplified in appearance and design, but retaining the superb operating characteristics that have made former Copes valves so outstanding.

It is the new Type CV-P, for application where you need the ultimate in valve-operating force . . . more than is available from a diaphragm . . . where you need extremely precise positioning . . . where you want the finest valve that money can buy.

You can get this new Type CV-P Valve for pipe sizes up to 16-inch, for unlimited pressures.

Rangeability is high. Response can be characterized to meet your operating requirements.

Write, or get in touch with your Copes-Vulcan man for complete information.

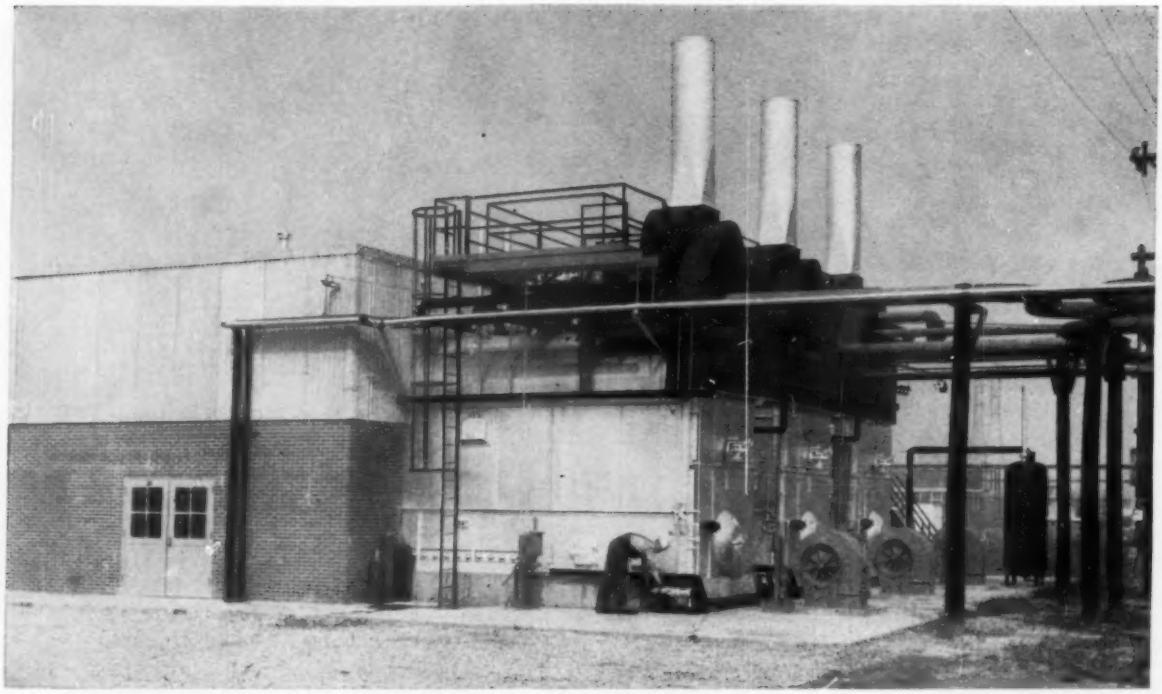
COPES-VULCAN DIVISION

BLAW-KNOX COMPANY

Erie 4, Pennsylvania

REDUCING VALVES

For more data circle 508 on Post Card



COMBUSTION CONTROLS GO OUTDOORS to help cut steam costs at American Synthetic Rubber Corporation's new packaged boiler plant near Louisville, Kentucky. The three 27,000 lbs./hr. gas or oil fired boilers operating at 175 psi generate steam for heating and processing.

"Big Station" Combustion Controls

Metering-Type Republic Control System Saves Fuel, Enables Boilers to Handle Fast Load Changes Quickly and Smoothly at American Synthetic Rubber Corporation

Peak combustion efficiency plus fast control of widely varying loads—these were combustion control requirements at American Synthetic Rubber Corporation's new packaged boiler plant near Louisville, Kentucky. To meet them, a metering-type combustion control system was specified instead of the "off-on" system usually furnished with packaged boilers. This system contains all of the basic control elements found in large installations and has all of the operating refinements common to large plants.

Is this metering-type control system worth its premium price? Flue gas tests made at various ratings conclusively answer the question with an emphatic YES. Combustion efficiency exceeds what similar packaged installations are delivering — and smoother operation is preventing chain-of-event troubles that frequently are caused by improper boiler operation. American Synthetic expects the controls to pay their extra cost in just a few years through fuel savings alone.

REPUBLIC FLOW METERS CO.

HOW METERING SYSTEM AT AMERICAN SYNTHETIC SAVES FUEL

Unlike most packaged boiler control systems, the Republic Combustion Control System at American Synthetic continuously measures both fuel and air inputs. Changes in fuel pressure, for example, which change the rate of fuel feed are detected immediately and automatically compensated for. Proper fuel-air ratio is maintained automatically at all ratings for maximum combustion efficiency.

Fast load changes are common in the plant with fluctuations varying as much as 8,000 lbs./hr. Rapid control response with Republic's dash-pot stabilization which prevents "hunting" enables boilers to meet new steam demands quickly and smoothly. Steam pressure and draft are held constant even during changing loads by the controls.

CONTROL SYSTEM CHANGES WITH FUEL

On oil firing, the controls operate on a steam flow-air correction system. For safety on gas firing, the controls are transferred to an air flow-gas flow correction arrangement which prevents over-firing in case air to the boilers is limited or blocked for any reason.

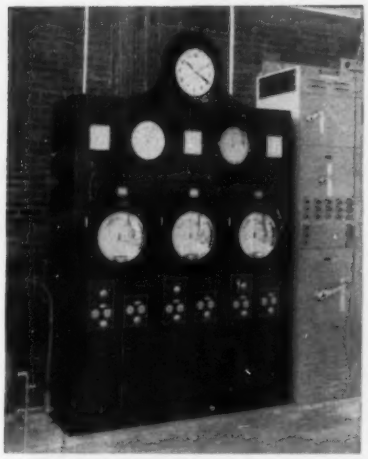
OPERATORS ARE ENTHUSIASTIC

The automatic correction feature of the Republic Controls eliminates time-consuming gas analysis and adjustments which would be necessary periodically with other types of controls. Correct operation of the boilers is easier, surer.

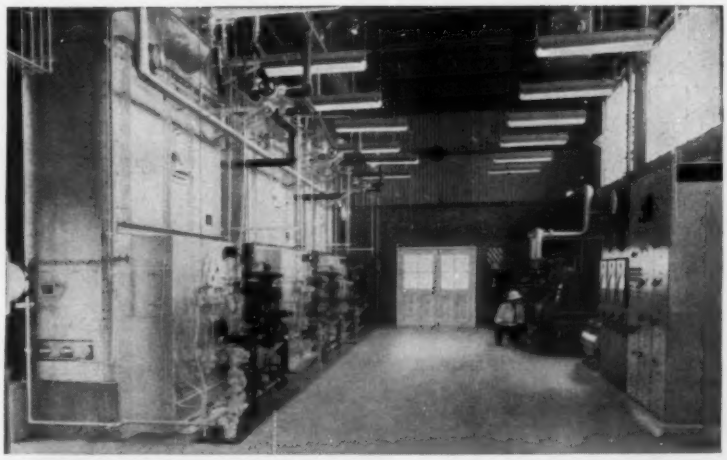
IF YOU ARE PLANNING ON INSTALLING PACKAGED BOILERS, find out how metering-type combustion control by Republic can improve efficiency, cut fuel costs and make operation simpler and easier. Contact your nearest Republic representative.

IF YOU ARE PLANNING *ANY* BOILER PLANT—any size, type or method of fuel firing — you can be sure of maximum efficiency with a Republic Combustion Control System engineered to exactly meet your needs. Write us when your problem is combustion control.

Pay Off for Packaged Boiler Plant



CENTRALIZED instrument and combustion controls on this Republic panel make checking and manual operation convenient and easy.

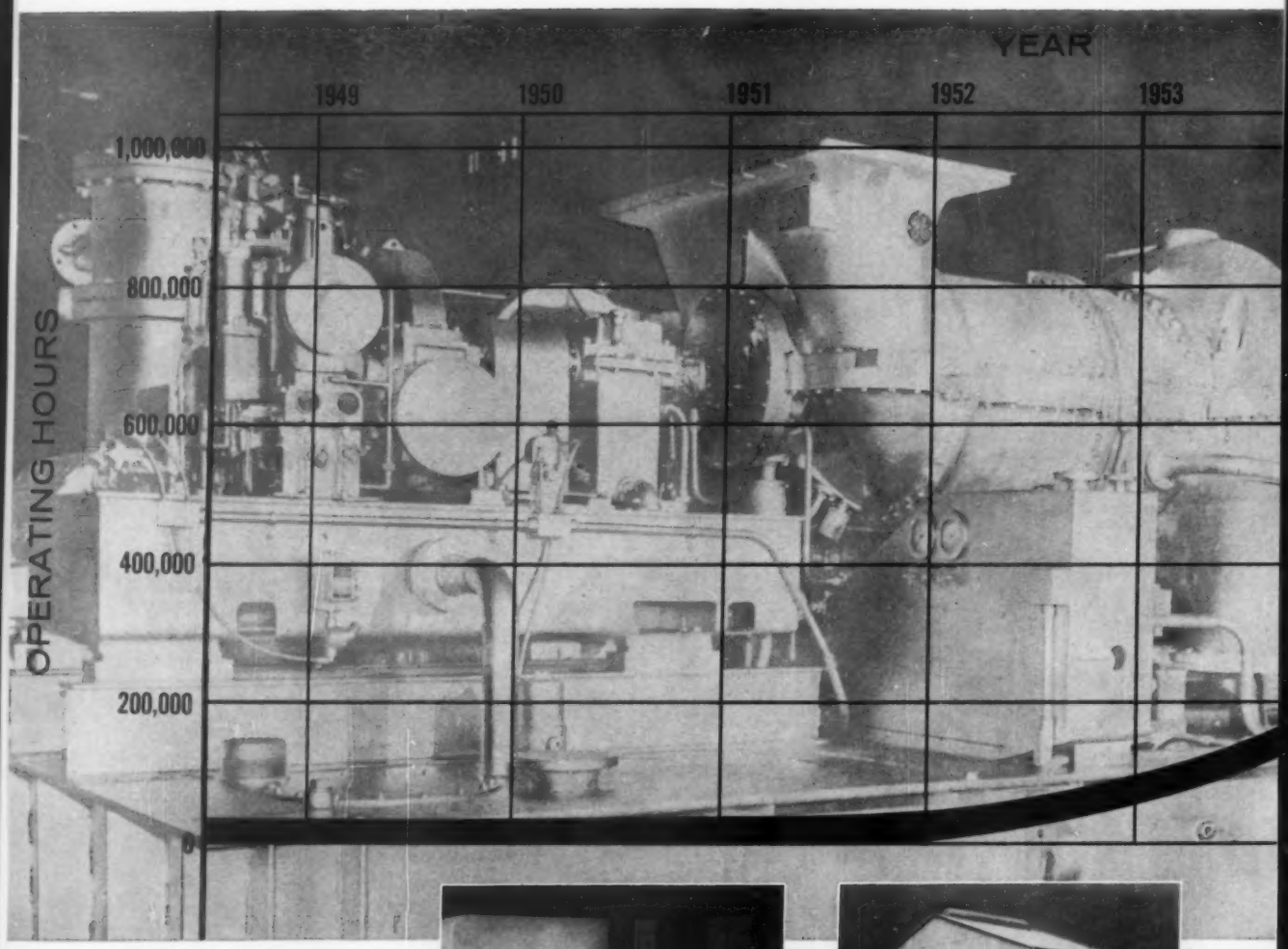


LOOKS EFFICIENT . . . AND IS. Interior view of the boilerhouse. All three boilers can be operated together or separately by means of control panel at right.

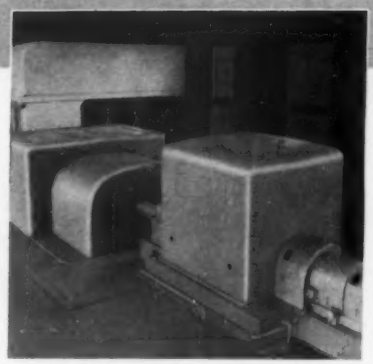
2240 Diversey Parkway • Chicago 47, Illinois

For more data circle 509 on Post Card

General Electric Gas top 1,000,000 hours



The Million Hours of operating time shown on the graph above have been logged in applications similar to those shown at right →

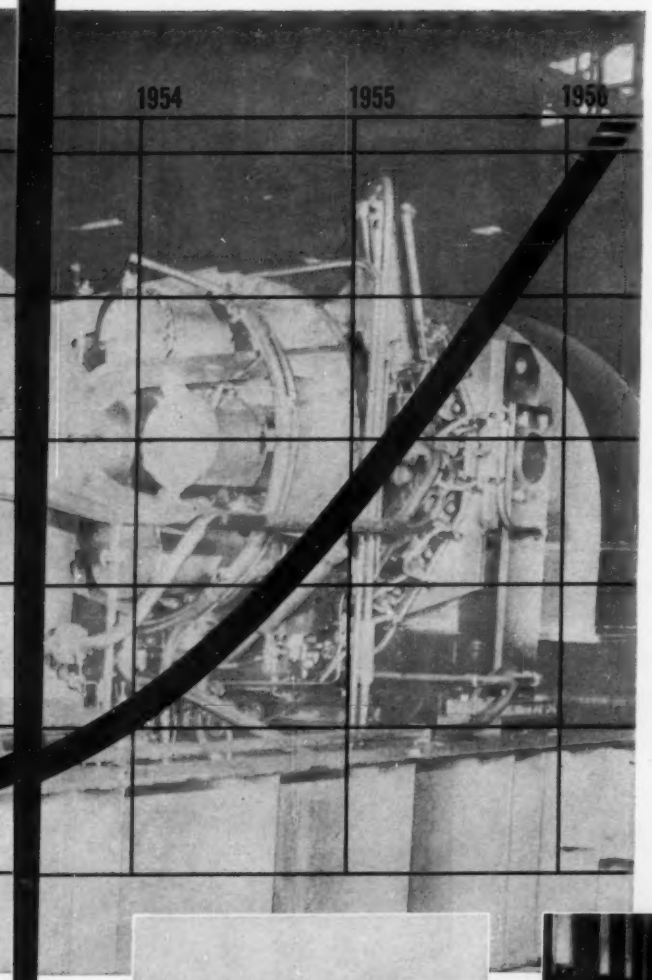


IN POWER GENERATION, G-E gas turbines are continuing to prove an economical addition to steam turbine-generator systems. In one installation, the addition of a gas turbine to the steam station cycle improved the heat rate 15%. Naturally, improvements will depend on existing station conditions.

IN GAS PIPELINE PUMPING, G-E units lower pumping costs. G-E gas turbines are ideal for these installations as they go on the line in iess than 15 minutes, can operate virtually unattended, use gas from pipeline as fuel. Little or no water, only a small amount of lubricating oil are required.

Turbines of service

Now, new ratings from 4750 to 28,400 kw promise even wider use of G-E units in electric utility power generation



With an impressive 1,000,000 hours to their credit in varied applications, General Electric gas turbines are now becoming an increasingly important consideration in the selection of power plants for utility power generation. As versatile, low-cost, self-contained power makers, they offer particularly attractive opportunities for use as peak-load and standby units—as well as in small and medium base-load plants, end-of-line generating installations and combined gas turbine-steam turbine cycles.

LOW OPERATING COSTS of General Electric gas turbines have been proved through 114 machine years of service in more than 100 industrial and utility installations. Suitable for remote, unattended operation and containing few wearing parts, a G-E gas turbine power plant requires very little maintenance. According to one user, maintenance costs have amounted to only 0.2 mills per kilowatt hour. In addition, installation cost per kilowatt is less for a General Electric gas turbine-generator station than for other complete power plants of comparable size. Gas turbines up to 9200 kw are shipped and installed on an integral base requiring only a small area and a simple foundation.

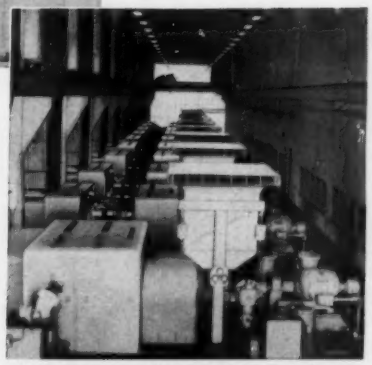
NEW RATINGS FROM 4750 to 28,400 kw promise to open up a broader field of application where the unique features of the gas turbine can bring even greater economies.

Your nearest Apparatus Sales Office will be glad to consult with your engineers and show how the special advantages of a G-E gas turbine can be applied to your operation. Or write Section 261-18C, General Electric Co., Schenectady 5, N. Y.

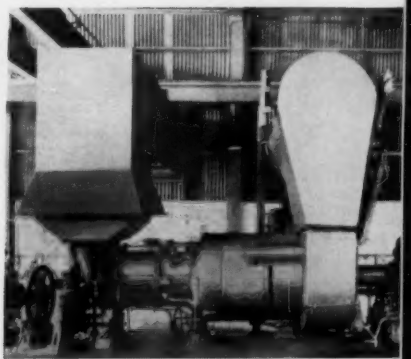
Progress Is Our Most Important Product

GENERAL ELECTRIC

IN RAILROADING, G-E gas turbines have proved their dependability under severe operating conditions. Utilizing low-cost residual fuels, units pack tremendous power for their size and weight. A new G-E 8500 hp gas turbine-electric locomotive can do the work of 5 diesel locomotives.



IN PETROLEUM PRODUCTION, G-E units are used in oil-field pressure maintenance. Driving centrifugal compressors, G-E gas turbines re-inject high pressure gas to oil fields . . . thus increasing petroleum yield. Simplicity of installation, ability to operate with little attention are prime advantages.

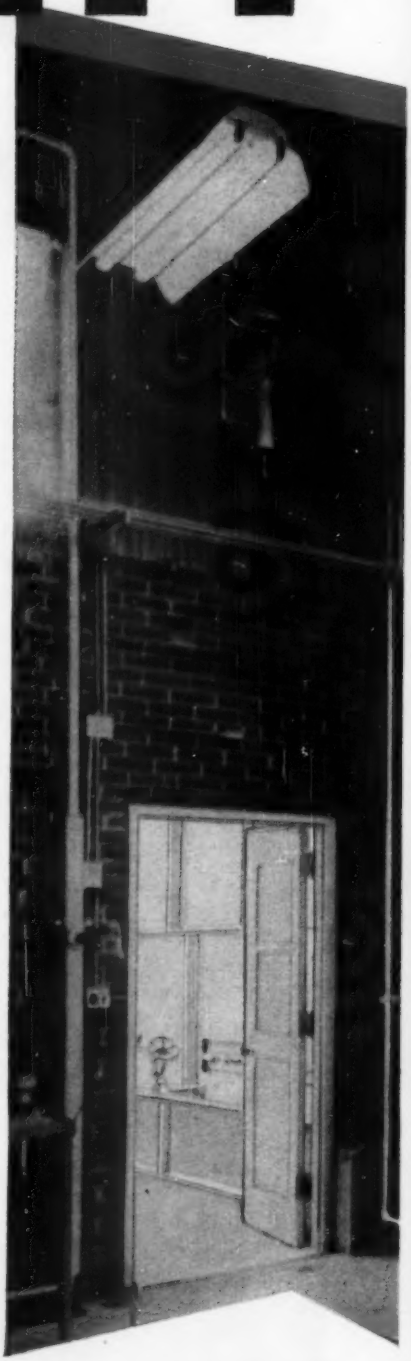


IN THE PETROCHEMICAL INDUSTRY, G-E gas turbine is relied upon for continuous 24-hour compressor service. In addition, significant savings are realized by using the hot exhaust gas in heat recovery boiler to make process steam—a good example of the versatility of gas turbine operation.

For more data circle 510 on Post Card

ERIE CITY

For Future--- Stoker Firing



• Now it's possible to obtain the advantages of completely packaged gas and oil fired steam generators and still provide for future stoker firing. Erie City VL's are designed as a true package with furnaces properly proportioned and arranged for easy conversion to stoker firing.

These Erie City VL type package steam generators are arranged for either forced or induced draft operation and are shipped shop assembled with brickwork installed. Controls and Burners are piped, wired and mounted — and remember — Erie City package boilers are Factory Fire Tested prior to shipment. All this ready for your basic service connections plus having a boiler designed for the future installation of an Erie City stoker.

• *When American Synthetic Rubber Corporation of Louisville, Kentucky modernized its steam facilities, they turned to Erie City Packaged Power. Installed there are three 25,000 pounds per hour VL type packaged steam generators complete with Erie City steam atomizing combination gas and oil burners and arranged for the future installation of Erie City Underfeed Stokers.*

For complete VL boiler data ask for SB-433

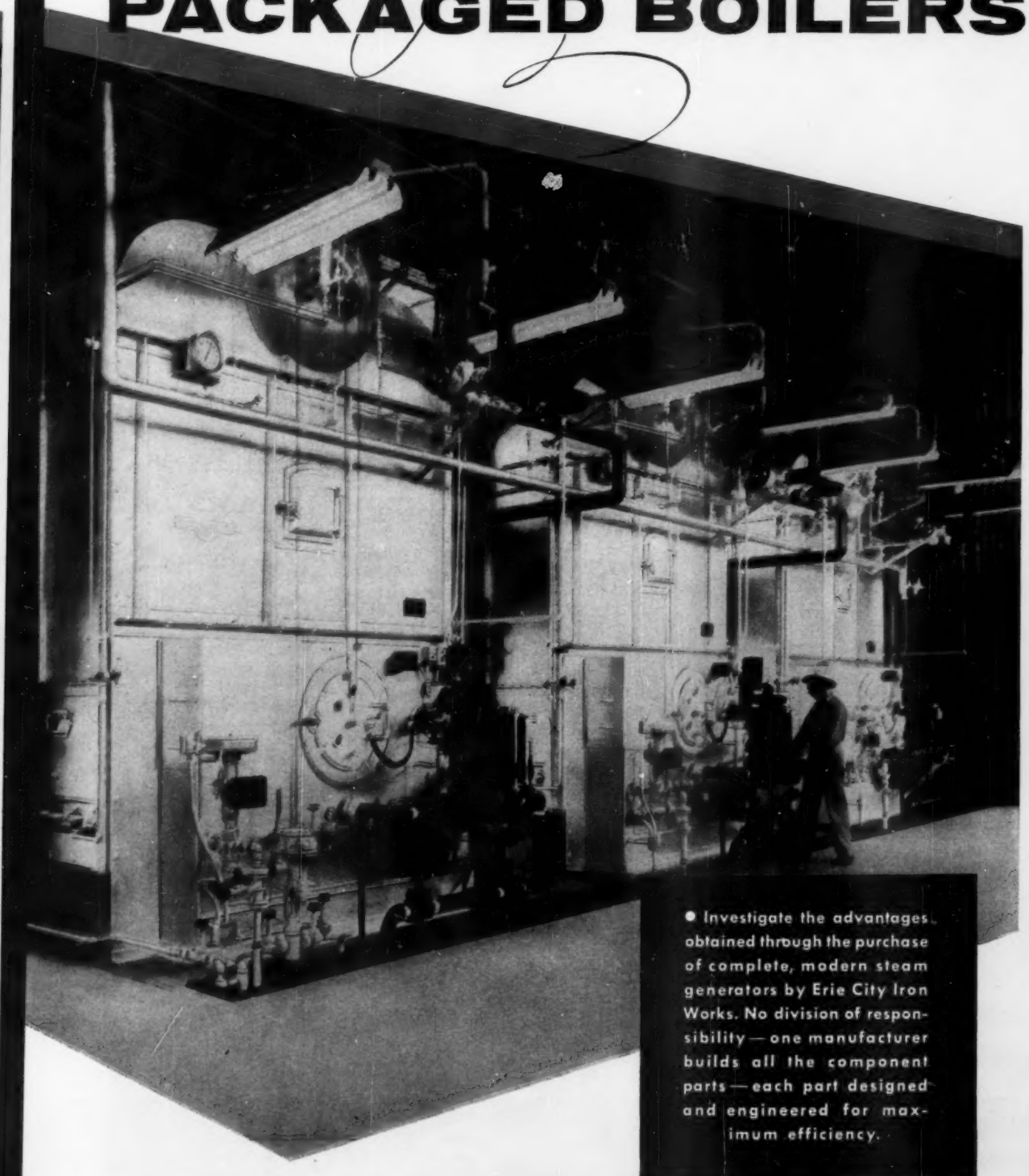
ERIE CITY
116 Years in Steam Generation

You can depend on Erie City for sound engineering

ERIE CITY IRON WORKS • *Erie, Pa.*

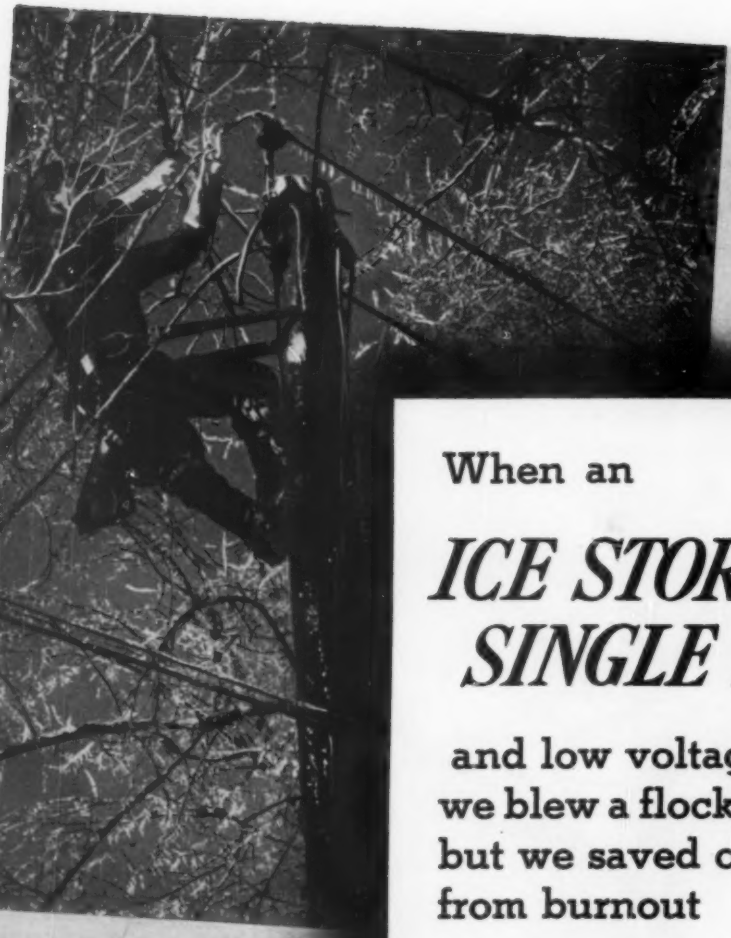
STEAM GENERATORS • SUPERHEATERS • ECONOMIZERS • AIR PREHEATERS
UNDERFEED AND SPREADER STOKERS • PULVERIZERS

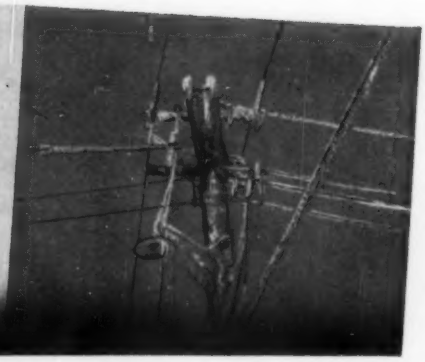
Oil and Gas PACKAGED BOILERS



• Investigate the advantages obtained through the purchase of complete, modern steam generators by Erie City Iron Works. No division of responsibility — one manufacturer builds all the component parts — each part designed and engineered for maximum efficiency.

For more data circle 511 on Post Card





When an

ICE STORM CAUSED SINGLE PHASING

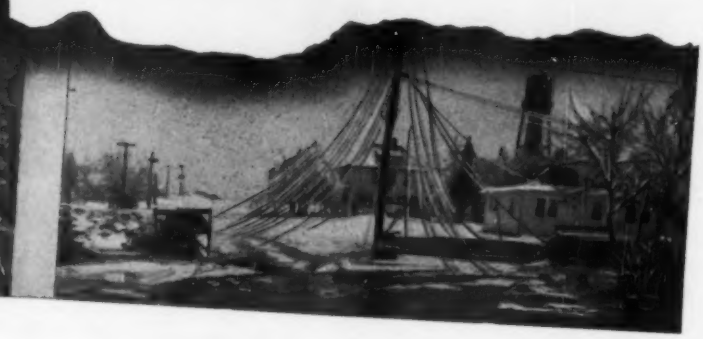
and low voltage conditions . . we blew a flock of Fusetron fuses but we saved over 40 motors from burnout

"For twenty-four hours after the bad ice storm of February 15, 1950 we were endangered by single phasing and low voltage conditions due to the damage done the power lines by the ice.

"During this period, we blew a flock of Fusetron dual-element fuses—around 240 in fact—but we figure that was a very cheap price to pay for saving over 40 motors from burning up.

"After this experience we didn't lose any time in putting all of our plant and equipment under Fusetron Fuse protection."

Michael G. Kupcho,
Master Mechanic
Ashland Shirt and Pajama Company
Ashland, Pennsylvania



You too, can be safe from electrical hazards by using

Fusetron DUAL ELEMENT Fuses

They provide 10 Point Protection

1 High interrupting capacity—protect against heaviest short-circuits. Have proven on tests to open safely on circuits set to deliver in excess of 100,000 amperes.

2 Protect against needless blows caused by harmless overloads.

3 Protect against needless blows caused by excessive heating—lesser resistance results in cooler operation.

4 Provide thermal protection — for panels and switches against damage from heating due to poor contact.

5 Protect motors against burnout from overloading.

6 Protect motors against burnout due to single phasing.

7 Give DOUBLE burnout protection to large motors — without extra cost.

8 Make protection of small motors simple and inexpensive.

9 Protect against waste of space and money — permit use of proper size switches and panels.

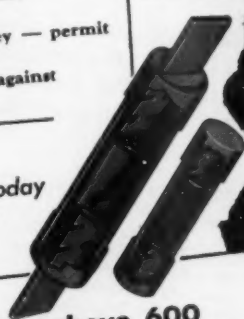
10 Protect coils, transformers and solenoids against burnout.

Write for bulletin FIS.

DON'T RISK LOSSES — *Start today to install FUSETRON fuses throughout the entire electrical system!*

Mabel Rohrke

"Obtaining will not smea... when some on... cement on th... Fotocaster t...



FUSETRON

TRUSTWORTHY NAMES IN ELECTRICAL PROTECTION

BUSS

For loads above 600 and up to 5,000 amps., . . . use BUSS Hi-Cap Fuses . . .

They have unlimited interrupting capacity to handle any fault current regardless of system growth.

Overload protection as well as short-circuit protection.

Coordinated with Fusetron fuses on feeder and branch circuits to limit fault outages to circuits of origin.

Dependable service through the years because there are no moving parts to stick or get out of order.

Write for bulletin HCS.

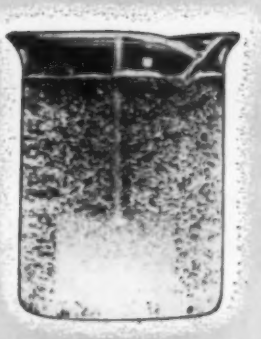
BUSSMANN MFG. CO. (Div. of McGraw Electric Co.) St. Louis 7, Mo.

For more data circle 512 on Post Card

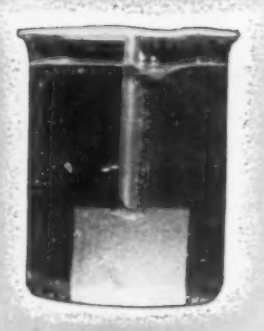
A New, Better Coagulant

NALCO 600

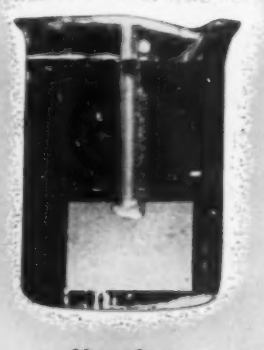
POLYELECTROLYTE



Alum



Alum plus
typical polyelectrolyte



Alum plus
Nalco 600

● As a coagulant in water clarification, and under many process coagulation conditions, new and different Nalco 600 has shown such great promise, both in performance and economy characteristics, that it has now been made available for general use as an established member of the Nalco family of chemical aids to industry.

Extremely difficult coagulation conditions provide especially economical applications for Nalco 600. It can be used alone or in conjunction with other coagulants. A very low dosage of Nalco 600 usually permits as much as 50% reduction in dosage of alum, activated silica, iron sulfate or clay type treatments . . . and results in a cleaner, clearer supernatant liquid.

Nalco 600 was invented in the Nalco Laboratories, and is being manufactured *only* by Nalco. For complete data on Nalco 600, and expert technical assistance to solve your clarification and coagulation problems, call Nalco now.

NATIONAL ALUMINATE CORPORATION

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6224 West 66th Place • Chicago 38, Illinois
IN CANADA: Alchem Limited, Burlington, Ontario
NORTHWESTERN UNITED STATES, HAWAII and ALASKA
The Flox Company, Inc., Minneapolis 3, Minnesota
ITALY: Nalco Italiana, S.p.A. SPAIN: Nalco Espanola, S.A.
WEST GERMANY: Deutsche Nalco-Chemie GmbH

ANOTHER *Nalco*® **PRODUCT. Serving Industry through Practical Applied Science**

For more data circle 513 on Post Card

HELPFUL BULLETINS

WATER CONDITIONING

101 Cooling Water Treatment — Process Bulletin C1 describes company's treatment for cooling tower systems: synergized polyphosphates plus low pH. Explains how synergized polyphosphates and lower pH conditions prevent scale, corrosion and wood rot as well as cutting maintenance costs and downtime. National Aluminate Corp.

102 Water Softeners—Cutaway drawings in Bulletin MSP-123 illustrate construction of company's water softeners, and indicate simple connections by which a softener is fitted into a water system. Capacities of the various models are given, together with specifications. Hagan Corp.

103 Feedwater Treatment — Process Bulletin B1, "Treatment of Boiler Feedwater by Direct, or Internal Method," discusses advantages of direct treatment, as a complete treating program or as a supplement to external systems. Explains why direct treatment is convenient, economical and complete, and points out how it improves steam quality and reduces boiler maintenance costs and downtime. National Aluminate Corp.

104 Feedwater Heaters — New design features incorporating improved operating principles for deaerating feedwater heaters are described in Bulletin 614. A cutaway drawing of a vertical deaerating heater and several installation photos are included, along with selection charts for heaters. Elgin Softener Corp.

PUMPS AND PUMPING

105 For Tough Pumping — Form 7325, 6 pp, introduces a centrifugal pump for liquids containing solids, air or gases that is described as non vapor-binding, self-venting, non-clogging and self-regulating. Shows some of the difficult pumping jobs it handles, and explains and illustrates construction features. Ingersoll-Rand Co.

106 For Downhill Pumping — Bulletin 855 describes a line of controlled volume pumps designed for "downhill" metering of liquids and gases. Details operation and application of the new Minus Delta P line of controlled volume pumps. Also gives specifications, capacities and important features. Illustrations and descriptive copy show applications in additive injection, bottle filling, proportional feed and fluid sampling systems. Milton Roy Co.

107 Pumps, Other Equipment — General information on company's vacuum and liquid pumps, air brake equipment, and hydraulic motors, controls and pumps is presented in 16-pp Bulletin 1102. Illustrated with installation photos from a wide range of industries, booklet is intended to serve as a guide to equipment produced by company's five divisions. The New York Air Brake Co.

108 Seals for Process Pumps — Fully illustrated with sectional drawings and cutaways, this 12-pp booklet details several types of Mechanipak seals for process pumps. Gives information on recommended services and seal parts and their functions. Also provides general data on these self-contained seals, and gives details and advantages of company's spare parts plan. Garlock Packing Co.

109 Process Pumps — Twenty-pp Form 7094-B describes vertically-split, single-stage and two-stage type process pumps. Provides design features, dimension tables, sectional and installation views and a chart showing interchangeability of parts throughout the line. Pumps covered offer capacities to 3200 gpm, heads to 925 ft at temperatures ranging up to 800 F. Ingersoll-Rand Co.

ELECTRICAL

110 Low Voltage Switchgear— Twelve-pp Bulletin 6004B presents low voltage switchgear of the metal-enclosed, drawout type for indoor and outdoor installation using Types K and LG air circuit breakers. Design and construction details are explained and illustrated; emphasis is placed on safety advantages afforded by test position with door closed. General specifications and standard frame arrangements included. I-T-E Circuit Breaker Co.

111 Cable Compound — Test Results and service records on an improved butyl rubber compound for high-voltage cables are announced in 12-pp Bulletin EB-27. Covers resistance to ozone, operating temperature, high-voltage, dielectric strength, aging, insulation resistance, mechanical moisture absorption, electrical moisture absorption, capacity and power factor. Diagrams, charts and tables amplify text. Anaconda Wire & Cable Co.

112 Control Transformers — Bulletin GED-2767, 32-pp, describes control transformers, including autotransformers, machine tool transformers, and special application models. Contains ratings, dimensions, product features, model numbers, list prices, weights, and wiring diagrams. A special section shows panel and machine tool voltage regulation curves. General Electric Co.

113 Fuses for All Uses — This revised edition of manufacturer's Complete Line Folder 3 includes illustrations and descriptions of fuses for every purpose. Features dual-element cartridge fuses for time-lag in protection against overloads, and delay renewable fuses and renewal links. Economy Fuse & Mfg. Co.

LIGHTING, COMMUNICATION

114 Modern Outdoor Lighting— Sixteen-pp "Outdoor Lighting with Flexiglas," presents information on some advanced methods of lighting outdoor areas evenly, with minimum glare and low operating costs. Describes and pictures the fluorescent luminaire fitted with protective diffusing shields of weather-resistant Plexiglas. Discusses quality of light delivered, and the maintenance, safety and appearance features of such luminaires. Photos show installations in plant areas, parking lots, other places. Rohm & Haas Co.

115 More Light for Less Money — This 8-pp bulletin, MV-403, describes typical applications of mercury vapor lamps in industrial plants, in outdoor areas and in special situations. Sixteen mercury vapor lamps are described along with specifications and applications. Booklet also contains a list of common questions about mercury vapor lamps and their answers. Sylvania Electric Products Inc.

New and revised publications reviewed on these pages offer help on operating and maintenance problems. To order, use the handy Reader Service Cards provided on pages 115–116

116 Annunciator Systems — The modern concept of the annunciator function is the subject of 32-pp Bulletin 100-A, which covers general information on components of the system, sequences, annunciator cabinets, accessory equipment, engineering data, and NEC requirements. Tells what an annunciator system is and describes its advantages. Illustrates sequences, and points out functional variations to consider. Flexibility of circuitry is also illustrated and general dimensions shown. Panalarm Products, Inc.

HEAT EXCHANGING, COOLING

117 Plate Fin Exchanger — Design and application data on company's plate fin exchanger — a compact cross-flow heat exchanger with extended surface on both sides — is presented in this 8-pp illustrated bulletin. Results of moving air oxidation and aqueous corrosion tests are pictured. The Griscom-Russell Co.

118 Fluid Coolers — Bulletin S-395, 8-pp, describes dry type fluid coolers, units developed especially for economical liquid or gas cooling. Contains information on construction, performance and maintenance, as well as data on component parts. Illustrations and descriptions of actual applications, including gas compressor intercooling, jacket water and lube oil cooling, are also contained in bulletin. The Trane Co.

AIR CONDITIONING

119 Air Conditioning Blowers — Eighteen-pp Form 405B, on Rex blowers, shows 17 standard belt-driven air conditioning blowers, each available for top or bottom horizontal discharge. Uni-Pak universal models shown may be used to obtain any one of four discharge angles. Also included are five sizes of direct drive blowers. In addition to dimensions and performance data, booklet provides selection charts covering heating and cooling. Air Controls, Inc.

120 Air Recovery Panels — Bulletin 106-D covers Dorex Type G air recovery panels for removal of odors and vaporous impurities from recirculated air in comfort conditioning installations. Performance and selection charts are also included. Connor Engineering Corp.

VALVES, PIPING, FITTINGS

121 Segregating Valves — Data Sheet Ua covers slide gate type segregating valves for pneumatic materials handling systems. Describes application, design, and operation of these valves, and gives installation instructions together with dimension drawings and tables. Shows various models for automatic or remote operation (with air cylinders), as well as for local manual operation. The Allen-Sherman-Hoff Co.

122 Piping Flexibility Analysis — How processing and power piping costs can be reduced — in materials, design, and construction — is the subject of this 12-pp brochure. Details method of piping flexibility analysis, devised for evaluating stresses, reactions and deflections in complex piping networks. Analysis involves development and solution of simultaneous equations for determining forces and moments in the piping system. From these forces and moments, stresses and deflections are calculated. Describes company's piping model test and electronic computing facilities. The M. W. Kellogg Co.

123 Plastic Pipe, Fittings — Reference information for selection of company's unplasticized, rigid PVC pipe, where high chemical resistance and/or high impact resistance is desired is contained in the first of two new bulletins. Alpha 101 and Alpha 102 are described, together with charts showing mechanical, thermal, electrical, other properties. Installation data, applications chart listing industries where pipe is recommended, are included. Resistance to wide range of chemicals is shown. Companion bulletin describes threaded and socket solvent cement fittings for use with pipe. Alpha Plastics Inc.

124 Pipe Unions — Design and construction advantages of Dart unions are featured in illustrated Bulletin D-255. Sectional view points out important details, and specifications and list prices are given. The Fairbanks Co.

You'll save time in ordering bulletins by using the Reader Service Cards on page 115. Of course we honor letterhead requests—but it takes us somewhat longer to handle them.

125 Seamless Fittings — Power engineers in the chemical industry, as well as those concerned with refinery and power plant construction, maintenance and piping will be interested in 6-pp Bulletin FB-500, which furnishes in concise form the types and size ranges available of various welding fittings and flanges. Includes photos and lists dimensional tolerances. Tubular Products Div., The Babcock & Wilcox Co.

126 Expansion Joints — Data Sheet Wd describes expansion joints which accommodate expansion in long pipelines of pneumatic materials handling systems. Features such as longer life, tight sealing and simple design are covered. Perspective and cutaway drawings, together with information on application, construction and installation are included, as well as dimensions. The Allen-Sherman-Hoff Co.

127 Expansion Joints — Data Sheet Wd introduces a line of expansion joints engineered to accommodate expansion in long pipelines of pneumatic materials handling systems. Advantages offered are covered. Perspective and cutaway drawings, information on application, construction and installation are included. The Allen-Sherman-Hoff Co.

VIBRATION CONTROL

128 Vibration Mountings — Catalog SS-55 describes heavy-duty general-purpose steel spring vibration mountings which combine characteristics of steel springs with unusual damping, sway and thrust control elements. Describes construction details, methods of damping excursion as well as controlling sway and thrust. Load capacities and dimension tables, illustrations of typical installations and engineering services are also described. Industrial Div., T. R. Finn & Co., Inc.

129 Rubber Mountings — Bulletin 701 describes features and applications of manufacturer's bonded rubber lattice mountings, designed to solve problems of low frequency, high amplitude vibrations in heavy machinery. Illustrates mounting in use on a vibrating screen, heavy motor generator, foundry shakeout. A list of additional uses is included, along with dimensions and capacities. Lord Mfg. Co.

HOSE AND COUPLINGS

131 Hose Assemblies — Catalog 100, 32 pp, presents a wide range of factory assembled high, medium and low pressure hose assemblies for hydraulic, suction return and general applications. Such features as company's Max-Flo couplings are described. Also included are flow charts, nomographic chart, thread information, methods for computing length of hose assemblies. Anchor Coupling Co., Inc.

132 Flexible Metal Hose — Twelve-pp Catalog 152 features engineering data on the complete line of Flexon flexible metal hose. Covers full range of flexible metal hose products, along with complete coupling data. An easy four-step selection guide is included. Flexonics Corp.

133 Hose and Duct — Construction and general information on Flexaust hose and Portovent duct is presented in 6-pp Bulletin 60. Also lists industrial prices for various sizes and types, and suggested applications. The Flexaust Co.

134 Swaged Hose — Eight-pp Catalog S-1 shows company's line of swaged hose, hose ends and adapters readily available from distributors. Also featured is a simple, detailed swaged hose assembly numbering system, by which hose assemblies of any size, type, length, pressure and quantity can be ordered quickly. The Weatherhead Co.

135 Hose Couplings — This revised 20-pp catalog contains large cut-away views showing design and construction features. Also described are single-check valve and double-check valve modifications of the coupling which seal off one or both ends of a fluid line the instant coupling is disconnected. To facilitate ordering, tables and diagrams are included which indicate available coupling sizes and types of hose connection, and provide tips on selection. Coupling accessories are also described. Titeflex, Inc.

136 Coupling Data — Bulletin 240 describes a quick-connect, quick-disconnect H coupling, its uses and construction, with particular reference to U-packer which gives positive seal without compression set because of rubber distortion. A fully detailed cutaway of coupling is included and dimensions and ordering information given. Snap-Tite, Inc.

. . . Outstanding Among This Month's Catalogs

137 Electrical Standards— "The 400 American Standards in the Electrical Field" is a 60-pp booklet designed to help power engineers find the applicable standard on product in which they are interested. Gives briefs of each of the current IEC recommendations; a listing of all projects under Electrical Standard Board — including officers, sponsors and scopes of these projects. Also contains general information on ASA, EST and IEC. Explains how and why American Standards are developed and describes benefits. American Standards Association.

138 Air Compressors — Catalog 36, 44-pp, contains a comprehensive presentation of the ¼-through 20-hp line of company's air compressors. Designed as a text and guide for those interested in air compressors, bulletin includes a detailed engineering section, featuring selection information, and tables of computations that will insure correct installation for each job. Also contains descriptions, specifications, dimensions, engineering drawings and photos, as well as information on continuous operating outfits, accessories and controls. Brunner Mfg. Co.

139 Hot Water Heating — Manual 2685, 28-pp, contains a complete discussion of high temperature, high pressure hot water heating systems including design, installation and maintenance data. Appropriate drawings, charts, graphs and tables are used to amplify the text. C. A. Dunham Co.

140 Wire and Cable — Bulletin 1096, 16-pp, contains detailed information on electrical wire and cable, as well as insulation and protective covering. Two selection charts — one by application and environment and one by cable type — are a practical guide to selection of best cable for a particular application. Minimum standard industry specifications are listed for each insulation and covering. Trade names, products and applications are also given. The Okonite Co.

INSTRUMENTS AND CONTROLS

142 Remote Metering, Control — Bulletin 230-H4A, 8 pp, describes remote metering of flow, level, pressure, temperature, gate position and weight and control of pumps, chemical feeders, valves and levels by means of Chronoflo telemeters. Contains product photos and installation drawings in addition to discussion of system's operation. Builders-Providence, Inc.

143 Process Scanning, Logging — How the integration of process control with process scanning and logging is accomplished in the Trans Scan Log control system is detailed in illustrated 16-pp Bulletin 98268. Discusses advantages, tells

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how system operates, and illustrates typical "off-normal" sequence. A schematic diagram of complete system is included, along with specifications. Taylor Instruments Co.

144 For High Temperature Control — Bulletin PT 556 contains descriptive data, specifications and dimensions on company's Type P2T photoelectric pyrometer designed to provide greater flexibility in measurement of automatic high temperature control. Explains how pyrometer indicates temperature changes on a meter and provides relay action to give a signal or to control heating devices. Photoswitch Div., Electronics Corp. of America.

145 Tachometer — All Kinds — Bulletin 1048 describes nine types of tachometers, some portable, some for permanent mounting on machines, centrifugal, chronometric and vibrating reed types. Shows three new types recently announced — inches per minute indicator, surface speed indicator, and alarm contact tachometer. The Herman H. Sticht Co., Inc.

146 Liquid Level Transmitter — Eight-pp Bulletin 13-22 describes closed tank liquid level measurement and control with the Type 13 LA d/p cell liquid level transmitter. Diagrams show operation principle and suggested installation layout, with specifications and dimensions listed. Other liquid level components such as indicators, recorders and control valves are shown. The Foxboro Co.

147 Air Meter — Bulletin 55 describes the pushbutton Anemotherm — a self-contained, portable unit for measuring air velocity, air temperature and static pressure in heating, ventilating and air conditioning systems. Explains operation and describes uses in various type of systems. A number of photos illustrate time-saving and precision control features and operation. Anemostat Corp. of America.

148 Venturi Tubes and Nozzles — Advantages of manufacturer's Type TG venturi tubes and nozzles in liquid flow measurement in process industries, power plants, testing laboratories, and mainline metering are discussed in Bulletin 100. Construction and installation details, range of sizes and specifications are given. Simplex Valve & Meter Co.

149 Pneumatic Regulators — Eight-pp Bulletin H-2 lists precision-made pneumatic regulator equipment including: filter-regulator combinations, filters and regulators, relays, purge assemblies and control panels. Illustrated with cross section and dimensional drawings, bulletin also gives typical applications. Conoflow Corp.

150 Solenoid Pilots — Several types of solenoid pilots for use with company's regulating valves are described in Form 1010. Lists reasons for economies in on-off control, describes applications, and gives type of pilot, material of construction, maximum pressure and maximum temperature for two- and three-way pilots in steam, air, gas and liquid service. Schematic diagrams of typical applications are given. Spence Engineering Co., Inc.

151 Improved Shower Control — Safety advantages of the Hydroguard thermostatic controls for showers are outlined in illustrated Bulletin 366. Design and construction details are shown, capacity and applications in industrial plants and institutions cited. The Powers Regulator Co.

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valves, fittings and flanges by Vogt

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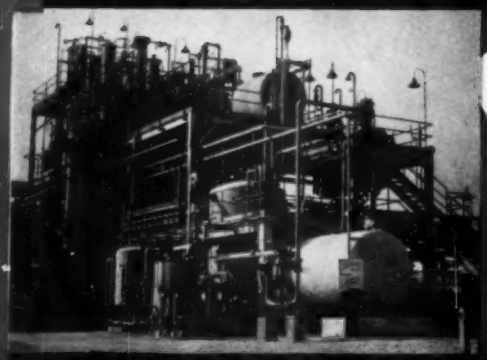

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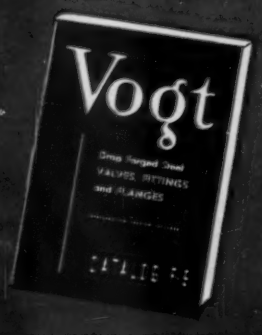

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152 Oil Leak Detection — Eight-pp illustrated Bulletin 80, on the Paraprobe oil leak detection system for steam-type fuel oil heaters gives a detailed explanation of the operation of the system. Provides installation diagrams, standard specifications, explains determination of condensate flow rate. Davis Engineering Corp.

153 Bagging Scale — Bulletin 3749A, 6-pp, describes a versatile bulk weighing scale for process weighing, electrically controlled and pneumatically operated. Discusses scale's heavy duty construction, capacity, accuracy, and process weighing features. Photos illustrate key features, as well as four different installations. Diagrams show dimensions, and feeding arrangements. Richardson Scale Co.

TUBING

155 Steel Tubing — Applications of tubular products in the process industry are discussed in 8-pp Bulletin TB-108, which lists tubing produced by company and technical literature available on stainless and alloy tubing, stainless pipe, stainless sanitary tubing, heat exchanger and condenser tubing, boiler tubing, and mechanical tubing. Table of chemical analyses, physical properties, and creep strength of 20 steels. Tubular Products Div., The Babcock & Wilcox Co.

156 For Sub-Zero Service — Bulletin TB-357, 6-pp, provides information pertaining to tubular products intended for sub-zero temperature applications. Lists typical applications, includes table of properties and characteristics. Tubular Products Div., The Babcock & Wilcox Co.

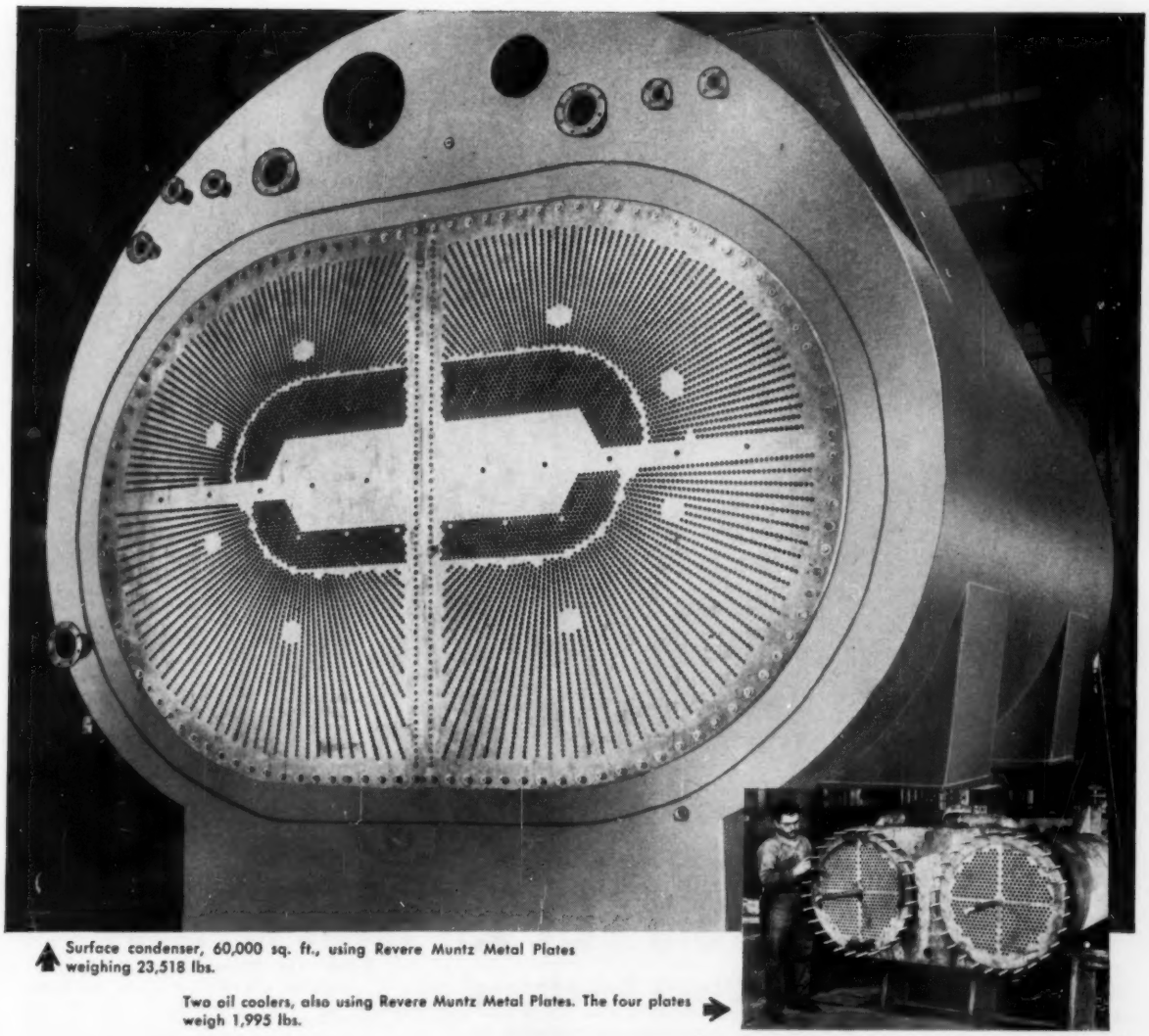
157 Heat Exchanger Tubes — Bulletin TB-329B, 8-pp, describes heat exchanger and condenser tubes, covering pertinent information on popular grades of carbon, alloy and stainless steel heat exchanger tubing, both seamless and welded. Also includes a special section dealing with the problems of installing heat exchanger and condenser tubes by the expanding method. The Babcock & Wilcox Co.

OTHER EQUIPMENT

158 Barometric Condensers — Form 9012-A describes company's barometric steam condensers of the disc-flow and ejector-jet types. Discusses such advantages as simplified construction which results in low cost maintenance, and illustrates typical installations. Cutaway drawings point out important design and operation details. Ingersoll-Rand Co.

159 Process Heating Equipment — Bulletin DV presents process heating equipment for use with Dowtherm A and E, Para-Cymene, Arclor 1248 and heat transfer oil. Described and illustrated are vaporizers (both packaged and field erected units), electrically-heated vaporizers and forced circulation liquid heating and cooling units which can be used to provide a wide range of controlled temperatures at low pressures. Union Iron Works.

160 Centralized Lubrication — Advantages of a centralized system of lubrication are discussed in 20-pp Bulletin 26-R. Tells how the Dualine measuring valve operates and how operation is supported by pumping units that provide a dependable source of lubricant pressure. How system helps maintain peak production is outlined. Fittings and accessories are also described. The Farval Corp.



▲ Surface condenser, 60,000 sq. ft., using Revere Muntz Metal Plates weighing 23,518 lbs.

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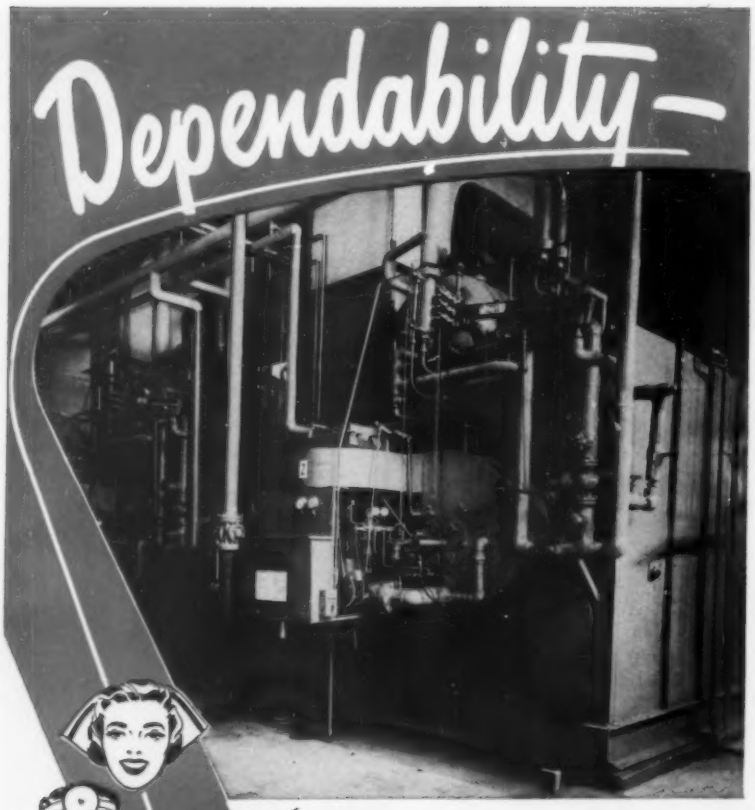

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161 Packaged Boilers—Bulletin A-1041, 8-pp, describes a line of self-contained, fully automatic packaged boilers. Range of sizes from the 12-hp unit to the 125-hp boiler are listed. Operating characteristics of gas, oil, and gas-oil burners are discussed along with recommendations for application. Eclipse Fuel Engineering Co.

162 Glass Fiber Products — Microlite and super-fine glass fiber insulation for heat control and sound absorption is described in Form WAF-1. Performance and conductivity charts for insulating blankets are given, along with properties and uses for acoustical applications and air duct installations. An acoustical baffle is also covered. L.O.F. Glass Fibers Co.

163 Nickel-Tin Bronzes — "Engineering Properties and Applications of Ni-Vee Bronzes," 28 pp, provides tables, graphs and photos on five basic Ni-Vee bronzes for industrial applications in which many brasses and bronzes are now used. The Ni-Vee alloys contain 5 per cent nickel, 5 per cent tin, and varying lead contents. Booklet recommends Ni-Vee types for construction, bearing and pressure castings, and explains cross-over applications. The International Nickel Co., Inc.

164 Chlorine Feeder — Bulletin 840-L23B describes a low-cost volumetric chlorine gas feeder, equipped with automatic safety features, and combining qualities of accuracy and dependability. Informative sections on operation, description, methods of control, safety features, plus photos and flow diagrams describe Model EVS. Builders-Providence, Inc.

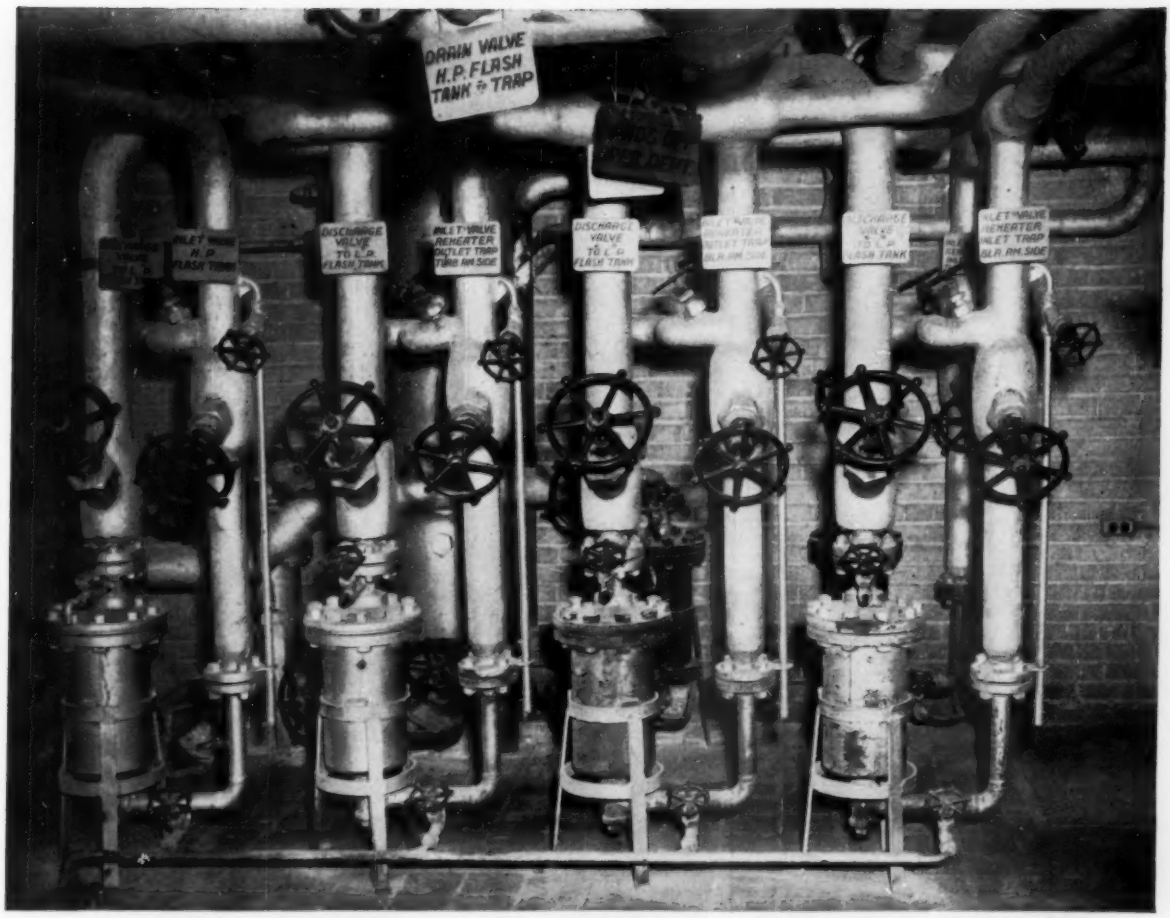
165 Heat Dissipation and Generation — Bulletin 90030. 8-pp, discusses the subject of heat generation and natural dissipation in hydraulic circuits. Features information on heat transfer area, oil circulation rate, auxiliary pumps, power pumps and pipes and valves, complete with charted test results. The Oilgear Co.

166 Oil Maintenance Equipment – Bulletin 172 offers pointers on diesel and gas engine lubricating and fuel oil maintenance. Includes general recommendations for lubricating oil filters, data on filter materials, and various filters for different applications. The Hilliard Corp.

167 Protective Coatings — This illustrated Catalog describes various corrosion resistant coatings systems manufactured by company. Includes suggestions in regard to selection of proper coating and specifications. Amercoat Corp.

168 Effective Ash Discharge — Bulletins 1753 and 1653 describe and illustrate Nuvaflow Fluidizers for ash storage bins. These units feature a development which slowly introduces low pressure air in the bottom of the ash storage bin, liquidizing the entire base of the ash pile so the ash flows uniformly out of the bottom discharge outlet into unloading equipment. United Conveyor Corp.

169 Thickeners, Clarifiers — Bulletin 31-E, 16-pp, describes thickeners, clarifiers and agitators for chemical, metallurgical and other processing operations in which separation of solids from a liquid is required. Discusses applications and shows construction details for Auto-Raise thickeners, circular and rectangular type clarifiers, agitators, and related equipment. A formula is provided for determining tank diameters. Hardinge Co., Inc.


DRAIN VALVE
H.P. FLASH
TANK & TRAP
DISCHARGE VALVE TO L.P. FLASH TANK
INLET VALVE REHEATER OUTLET TRAP THIS AM SIDE
DISCHARGE VALVE TO L.P. FLASH TANK
INLET VALVE REHEATER OUTLET TRAP

"Panel" of Eleven says Traps are Best for draining Superheated Steam Lines

. . . AND THESE PLANTS AGREE

Typical Armstrong high pressure trap users:

Consumers Power Company—
Comstock, Erie, Essexville, Muskegon, Zelwaukee, Michigan

Ohio Power Company, Phila, Ohio

Kansas City Power & Light—
Kansas City, Mo.

Georgia Power Company—
Yates, Macon, McManus, Georgia

United Illuminating Company—
New Haven, Conn.

Philadelphia Gas & Electric—
Philadelphia, Pa.

San Diego Gas & Electric—
San Diego, Calif.

Wisconsin Electric Power Company, Milwaukee, Wisconsin

Northern States Power Company—
St. Paul, Granite Falls, Black Dog, Minn.

Cincinnati Gas & Electric Company, Cincinnati, Ohio

One of the readers of a power plant publication recently asked, "which is the best device for removing condensate from lines carrying superheated steam . . ."

Eleven readers answerd this published question. *All* agreed, from experience, that steam traps are best.

Traps are automatic. Traps prevent steam loss. Traps take care of boiler carryover. Traps are available with sufficient capacity to take care of any condensate load. Traps don't "forget" to drain the lines.

Since 1929, Armstrong inverted bucket forged steel steam traps have kept pace with the trend to higher steam pressures. Today, they are widely recognized as essential safety devices in leading power plants throughout the world operating at pressures up to 2400 psig.

For safe, dependable drainage of superheated steam lines, get the facts about Armstrong traps. Call your local Armstrong Representative or write Armstrong Machine Works, 810 Maple St., Three Rivers, Michigan.

ASK FOR REPRINT—

"Should We Trap Superheated Steam Lines"—tells the experience of trap users . . . answers your questions on high pressure trapping. Ask for Catalog J, too . . . complete data on Armstrong forged steel traps. Free on request—no obligation.

Application Engineered

ARMSTRONG STEAM TRAPS

For more data circle 520 on Post Card

70 Years ago we used ads like this to tell buyers about Bell & Zoller Coal. We've done a lot of growing—and made a lot of changes since then. • But one thing hasn't changed—the famous free-burning, low ash, high heat-producing quality of Bell & Zoller products. • The proudest statement we can make on our 70th Anniversary is the same one we could make in 1886: Superb Quality Coal, We Mine It—ZEIGLER, MOSS HILL, ORIOLE, MURDOCK, LIBERTY SMOKELESS, BUCKHORN, SPARTA... and you can get it today through your nearest Bell & Zoller office.

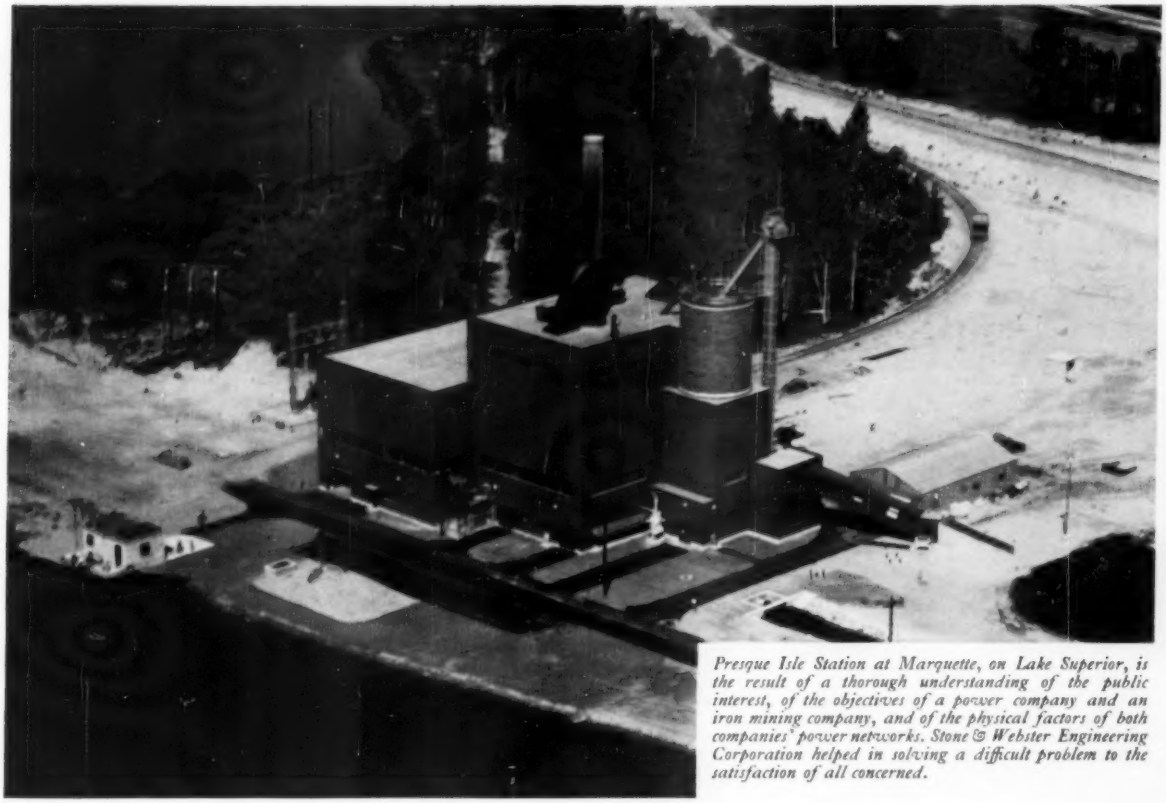
Bell & Zoller Coal Company

70 YEARS OF SERVICE TO COAL USERS

BELL BUILDING, CHICAGO 1, ILLINOIS

Cleveland • New York • St. Louis • Minneapolis
Omaha • Milwaukee • Louisville • Washington, D.C.
Terre Haute, Ind. • Mount Hope, W.Va.

For more data circle 521 on Post Card



Presque Isle Station at Marquette, on Lake Superior, is the result of a thorough understanding of the public interest, of the objectives of a power company and an iron mining company, and of the physical factors of both companies' power networks. Stone & Webster Engineering Corporation helped in solving a difficult problem to the satisfaction of all concerned.

SOLVING THE POWER PROBLEMS ON MICHIGAN'S UPPER PENINSULA

To meet the critical demand for more power in Michigan's Upper Peninsula region, the Upper Peninsula Power Company and The Cleveland-Cliffs Iron Company retained Stone & Webster Engineering Corporation to assist in their separate expansion programs.

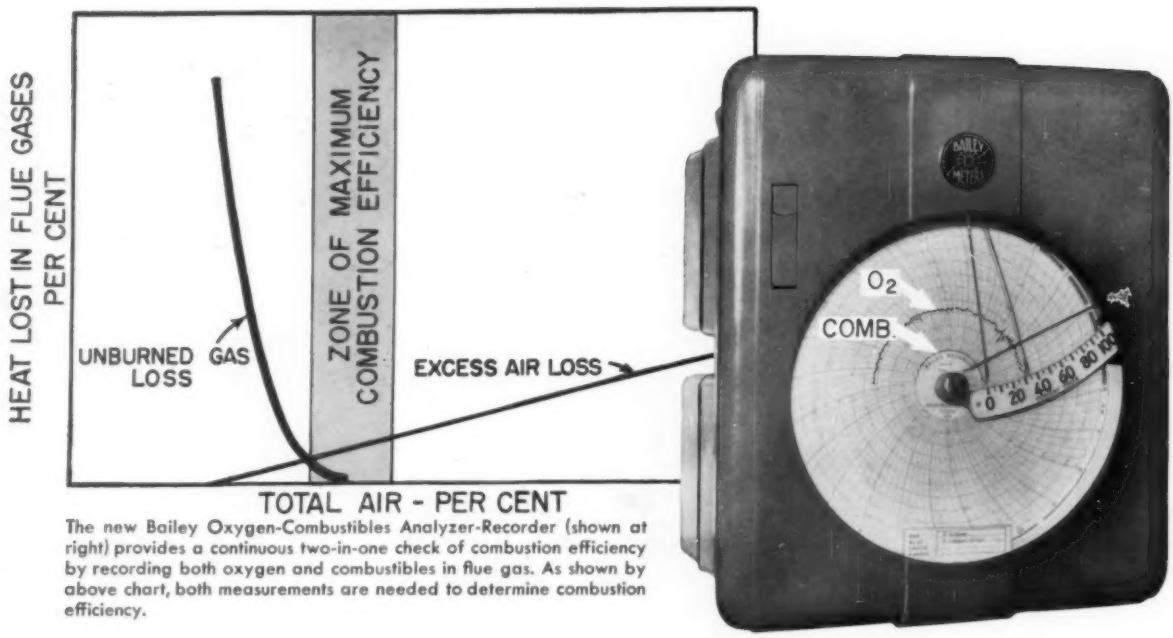
As a result of intensive studies and investigations of all aspects of the situation by the Engineering Corporation, it was decided to build a single jointly-owned steam power plant. Presque Isle Station was designed and built by the Engineering Corporation and is now on the line with initial installation of 22,000 kilowatts.

If you have a problem of design or construction, our broad experience in these and related fields may help you solve it. Write or call us for complete information on our services.

STONE & WEBSTER ENGINEERING CORPORATION

A SUBSIDIARY *of* STONE & WEBSTER, INC.

New York Boston Chicago San Francisco Los Angeles Houston Pittsburgh Seattle Toronto



The new Bailey Oxygen-Combustibles Analyzer-Recorder (shown at right) provides a continuous two-in-one check of combustion efficiency by recording both oxygen and combustibles in flue gas. As shown by above chart, both measurements are needed to determine combustion efficiency.

BAILEY announces • • •
New 2 in 1 way to measure Combustion Efficiency

The new Bailey Oxygen-Combustibles Analyzer-Recorder gives you a continuing double check on combustion economy. It's fast response measures and records:

1. Excess air—regardless of the fuel or combinations of fuels being burned.

2. The mixing efficiency of your fuel-burning equipment—by indicating the amount of combustibles in your flue gas, resulting from incomplete mixing of fuel and air.

Combustion efficiency depends upon fuel-air ratio. Too much fuel can be even more costly than too much air. And because of the interdependence of these two factors, no control that measures only one of them can give you complete protection.

Now, for the first time, you can check *both* with a *single* fast acting instrument, using the new Bailey Oxygen-Combustibles Analyzer-Recorder for industrial furnaces, kilns, heaters and boilers.

Fuel economy improves as excess air is reduced —until unburned fuel begins to show up in the flue gas. When this happens, combustion efficiency drops off sharply if there are further decreases in the air-fuel ratio. That's why combustion gases must be analyzed for *both* oxygen and combustibles to get a true indication of efficiency—and that is why Bailey coordinates both measurements on the same chart, to show when excess air may be reduced safely without danger of greater losses from unburned gases.

The Bailey Oxygen-Combustibles Analyzer is an approved combustion safeguard.

Ask your local Bailey engineer for suggestions on application. Equipment details in Product Specifications E65-1 and E12-5. P31-1

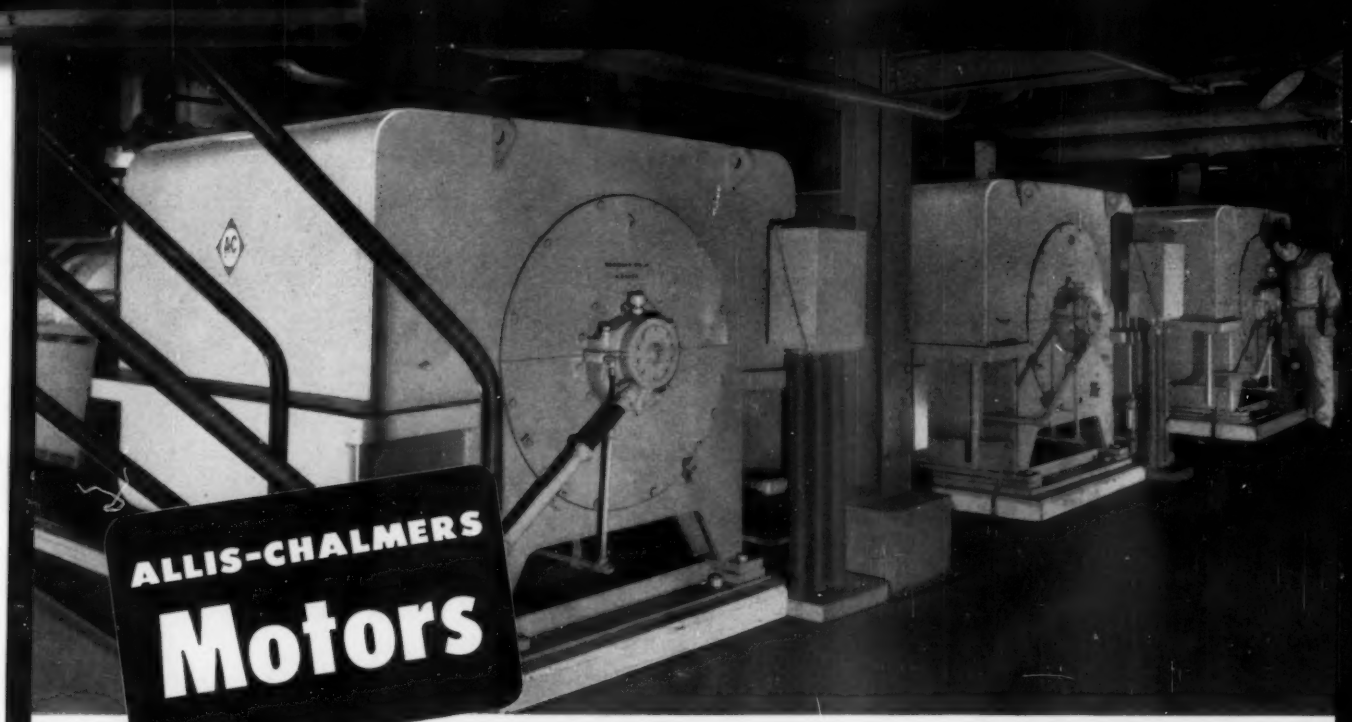
BAILEY METER COMPANY

1040 IVANHOE ROAD • CLEVELAND 10, OHIO

INSTRUMENTS AND CONTROLS

For Power And Process

For more data circle 523 on Post Card



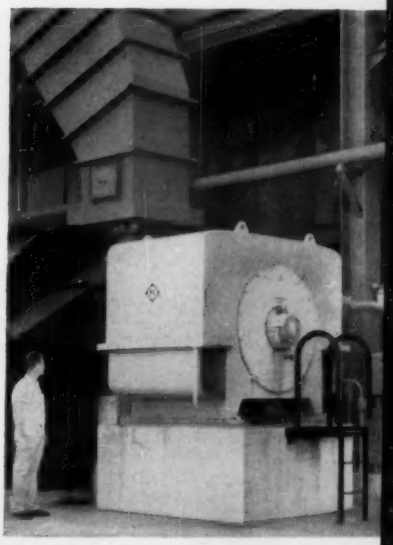
Driving ALL Major Auxiliaries

at Houston's New Webster Station

Weather-protected Allis-Chalmers motors are used throughout the modern outdoor Webster Station of Houston Lighting and Power Company. They provide low-cost outdoor installation plus dependable operation under all weather conditions.

These motors are but a few of the complete line of motors Allis-Chalmers builds for power plant service. Check with the A-C office in your district or write Allis-Chalmers, Power Equipment Division, Milwaukee 1, Wisconsin. A-4832

Three of the six 1750-hp, 3575-rpm, 2300-volt Allis-Chalmers two-pole motors providing unusually quiet drives for boiler feed pumps.



Two 350-hp, 1170-rpm, 440-volt Allis-Chalmers condensate pump motors.

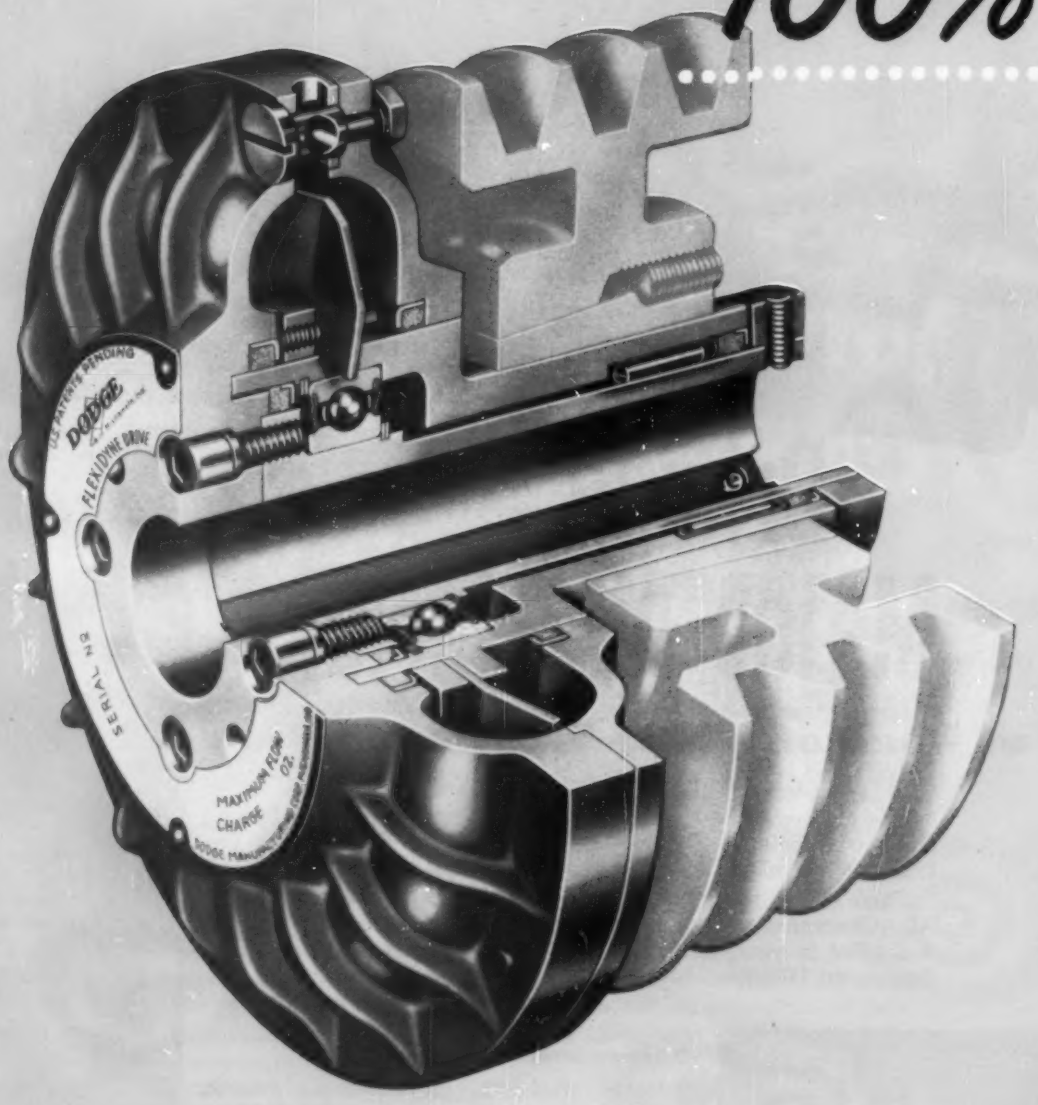
One of four 1250-hp, 880-rpm, 2300-volt cage motors driving forced-draft fans.

ALLIS-CHALMERS

Four 800-hp, 514-rpm, 2300-volt vertical Allis-Chalmers circulating water pump motors.

Engineers and Constructors — Ebasco Services Incorporated

100%



THE NEW DEVELOPMENT THAT

—STARTS LOADS SMOOTHLY

—PROTECTS AGAINST SHOCKS AND OVERLOADS

—SAVES POWER

—GIVES 100% EFFICIENCY AT FULL LOAD

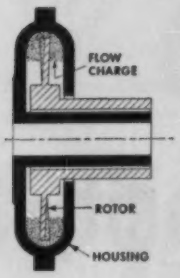
Efficiency at Full Load!

FLEXIDYNE

THE DRY FLUID DRIVE

Field experience proves that the new principle employed in Flexidyne provides a better way to handle difficult drive problems.

The "dry fluid" in Flexidyne is heat treated steel shot. A measured amount, called the flow charge, is contained in the housing, which is keyed to the motor shaft. When the motor is started, centrifugal force throws the flow charge to the perimeter of the housing, wedging it between the housing and the rotor which transmits power to the load.



After a momentary slip between housing and rotor the two become locked together and achieve full load speed without slip and at 100% efficiency during the running cycle.

Flexidyne is easy to select *off the shelf*. Each size has a standard horsepower rating, yet the flow charge can be varied quickly to give you tailor-made torque to suit the job.

Write for bulletin A-640, or call your Dodge Distributor now about Flexidyne Drives and Flexidyne Couplings.

DODGE MANUFACTURING CORPORATION
6400 Union Street, Mishawaka, Indiana

FLEXIDYNE AT WORK TURNS IN GREAT PERFORMANCE RECORD!

Flexidyne Drives and Couplings are now being delivered from stock. Already reports like these are coming in about Flexidyne performance in many tough assignments.

RAILROAD CAR PULLERS
"Starts fine... summer or winter!"

CONVEYORS
"We start under full load now!"

COTTON CARDS
"Finally... the soft start!"

TRAVELING CRANES
"Spots our loads... and how!"

PUMPS
"Now we are using smaller motors, too!"

VENTILATING FANS
"Takes off smooth as silk!"

...AND OTHER HEAVY INERTIA LOADS
"Wonderful performance!"

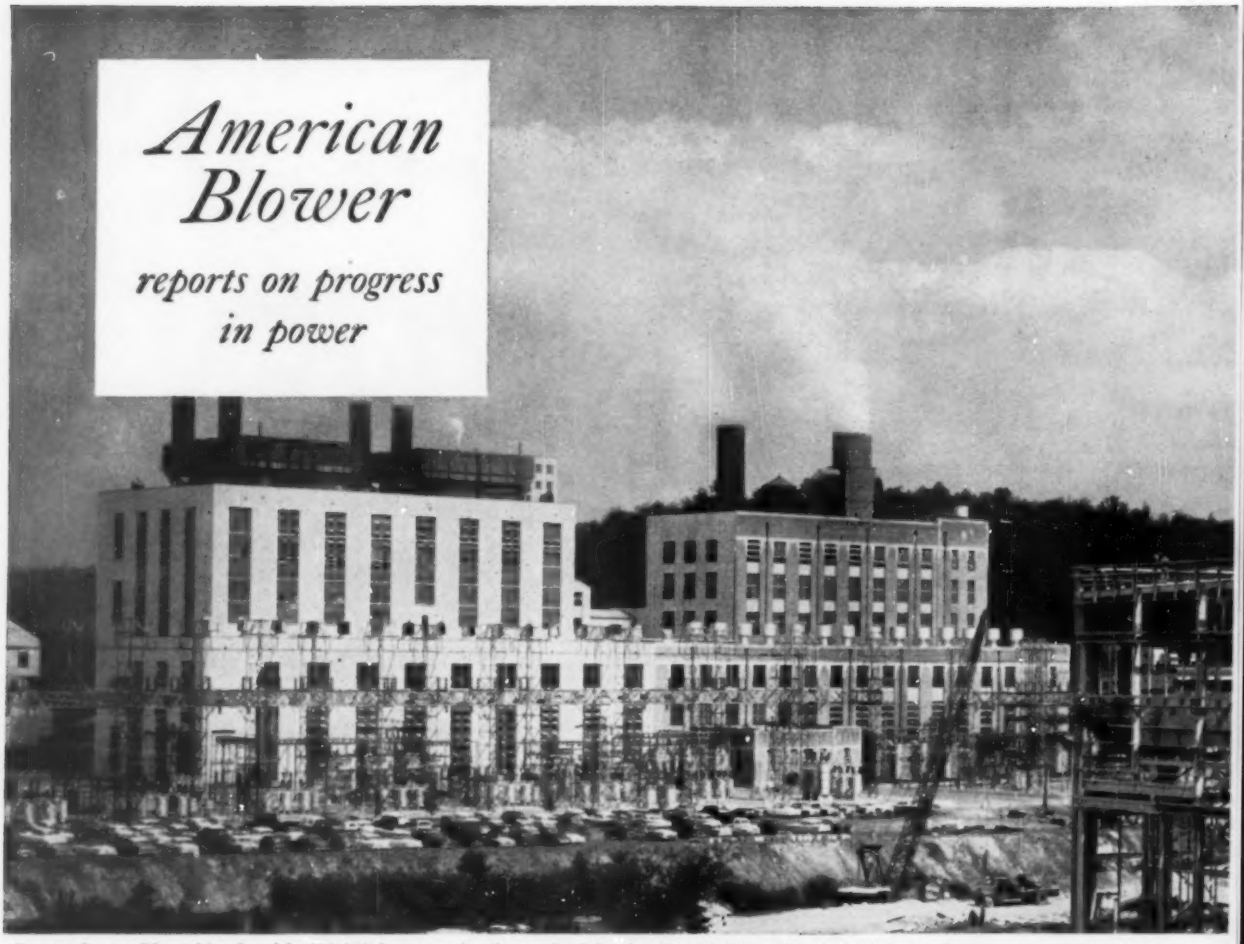
CALL THE TRANSMISSIONEER, your local Dodge Distributor. Factory trained by Dodge, he can give you valuable assistance on new, cost-saving methods. Look for his name under "Power Transmission Machinery" in your classified telephone book, or write us.

DODGE
of Mishawaka, Ind.

For more data circle 525 on Post Card

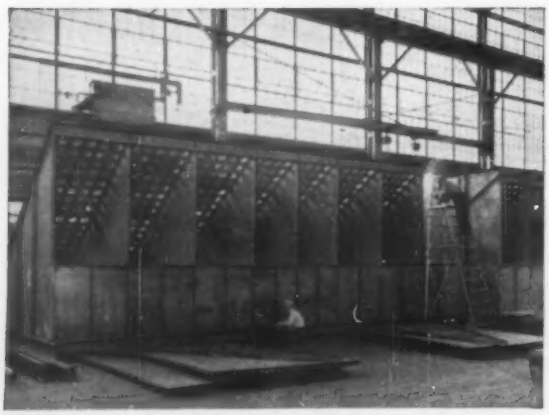
American Blower

reports on progress in power



Gorgas Steam Plant No. 2, with 428,000 hp capacity, is on the Warrior River. Plant No. 3 (right), under construction, will house

Alabama Power ups capacity to



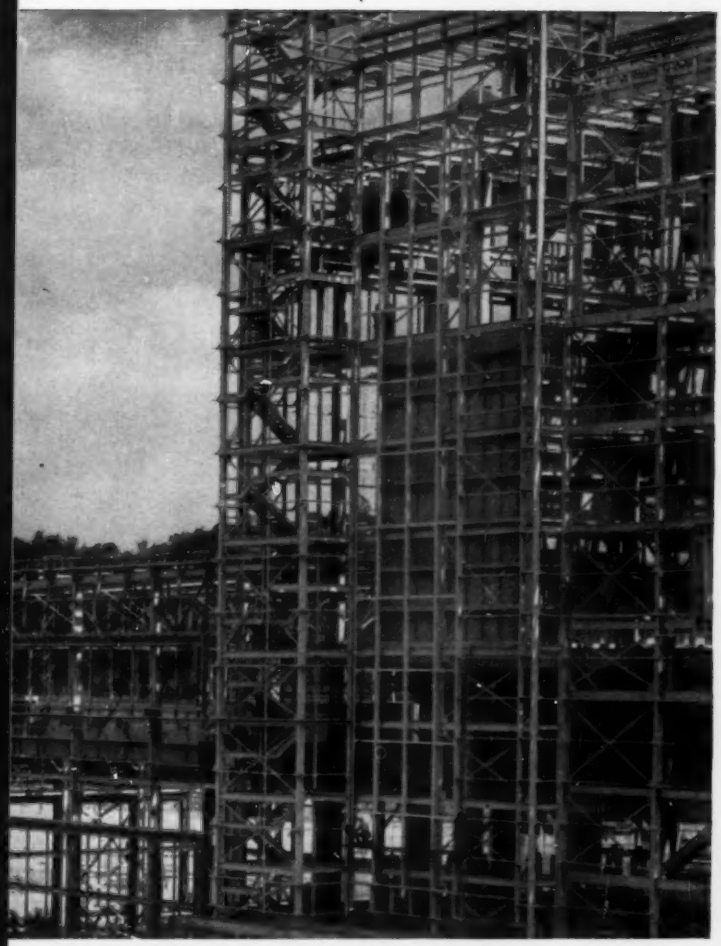
While Gorgas Steam Plant No. 3 is being built, American Blower constructs two Fly Ash Precipitators which will be installed in this new plant. Ratings: 340,000 cfm @ 285° F.

As in the past, Alabama Power installs American Blower equipment—in building for the future

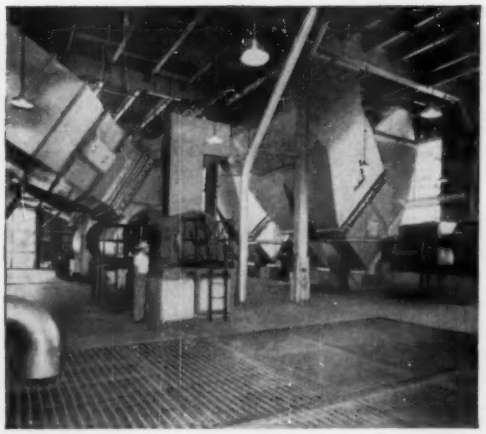
With six steam and six hydroelectric plants, the Alabama Power Company forges ahead for the future of Alabama. In 1955 alone, it will invest more than $35,000,000 in bigger and better electrical facilities, including an eighth generating unit at their Gorgas Steam Plants. When completed this year, Alabama Power's capacity will be over 2,000,000 hp!

American Blower Forced and Induced Draft Fans, Fly Ash Precipitators and Gyrol Fluid Drives are being installed in this new plant.

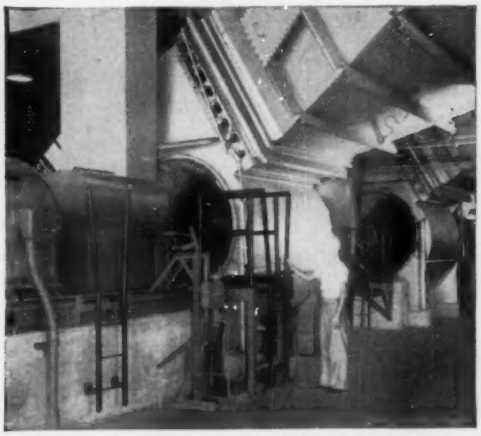
From coast to coast you'll find American Blower playing an important role in the expansion and modernization of many other progressive, investor-



No. 8 generating unit, rated at 208,000 hp.



Gorgas Unit No. 7 uses American Blower Fans with Gyrol Fluid Drives. Induced Draft Fans (above) are rated @ 262,500 cfm @ 270° F @ 15.25" sp @ 569 rpm.



American Blower Forced Draft Fans on Unit No. 7 at Alabama Power's Gorgas Steam Plant are capable of 180,000 cfm @ 140° F @ 11.00" sp @ 868 rpm.

over 2,000,000 hp!

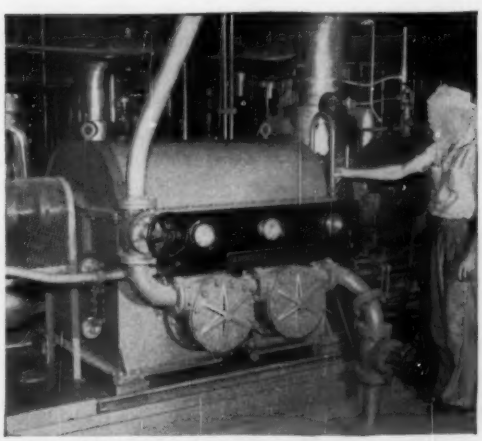
owned utilities. Plant operators have come to rely on American Blower Heavy-Duty Steam Coils and Fly Ash Precipitators, as well as our Mechanical Draft Fans, Dust Collectors, and Gyrol Fluid Drives for boiler-feed pump and fan control.

Give us a call to discuss *your* program. An experienced representative will gladly go over your requirements, and recommend equipment of the highest efficiency and economy. Contact your American Blower or Canadian Sirocco Branch Office.

AMERICAN BLOWER CORPORATION, DETROIT 32, MICHIGAN
CANADIAN SIROCCO COMPANY, LTD., WINDSOR, ONTARIO

Division of American-Standard

AMERICAN 75th ANNIVERSARY YEAR **BLOWER**



In addition to fan control, American Blower Gyrol Fluid Drives — class VI, 1500 hp — are used for adjustable speed control of boiler-feed pumps.

For more data circle 526 on Post Card

UNION ELECTRIC adds

Unit No. 3 at MERAMEC STATION will be served by a Foster Wheeler twin furnace, dual circulation, differentially fired, reheat steam generator of 1,850,000 lb/hr capacity

With the addition of this 275,000-kw Unit No. 3 at Meramec Station, Union Electric Company of Missouri will boost total station capacity to 560,000 kw, keeping well ahead of anticipated load growth.

The new turbine will be served by an FW steam generator with a maximum continuous capacity of 1,850,000 pounds steam per hour, 2150 psig at the superheater outlet, 1010F/1010F. This unit is unique in that it combines twin furnace arrangement, dual circulation and reheat—three major advances in modern, large capacity steam generator design. The selection of this combination is a gratifying expression of confidence in the efficiency and dependability of Foster Wheeler steam generating equipment.

The twin furnace design, a Foster Wheeler development, provides sufficient water-cooled and steam-cooled areas to prevent slagging of boiler and superheater surfaces. The use of combination radiant and convection surfaces for superheating, plus differential firing, permits constant final and reheat steam temperatures over a wide operating range, stabilizing steam conditions for maximum turbine efficiency.

Dual circulation, another Foster Wheeler development, has been incorporated as insurance against potentially troublesome silica deposition in the turbine.

Coal for the differential-fire-controlled furnaces will be pulverized in three Foster Wheeler Ball Mills.

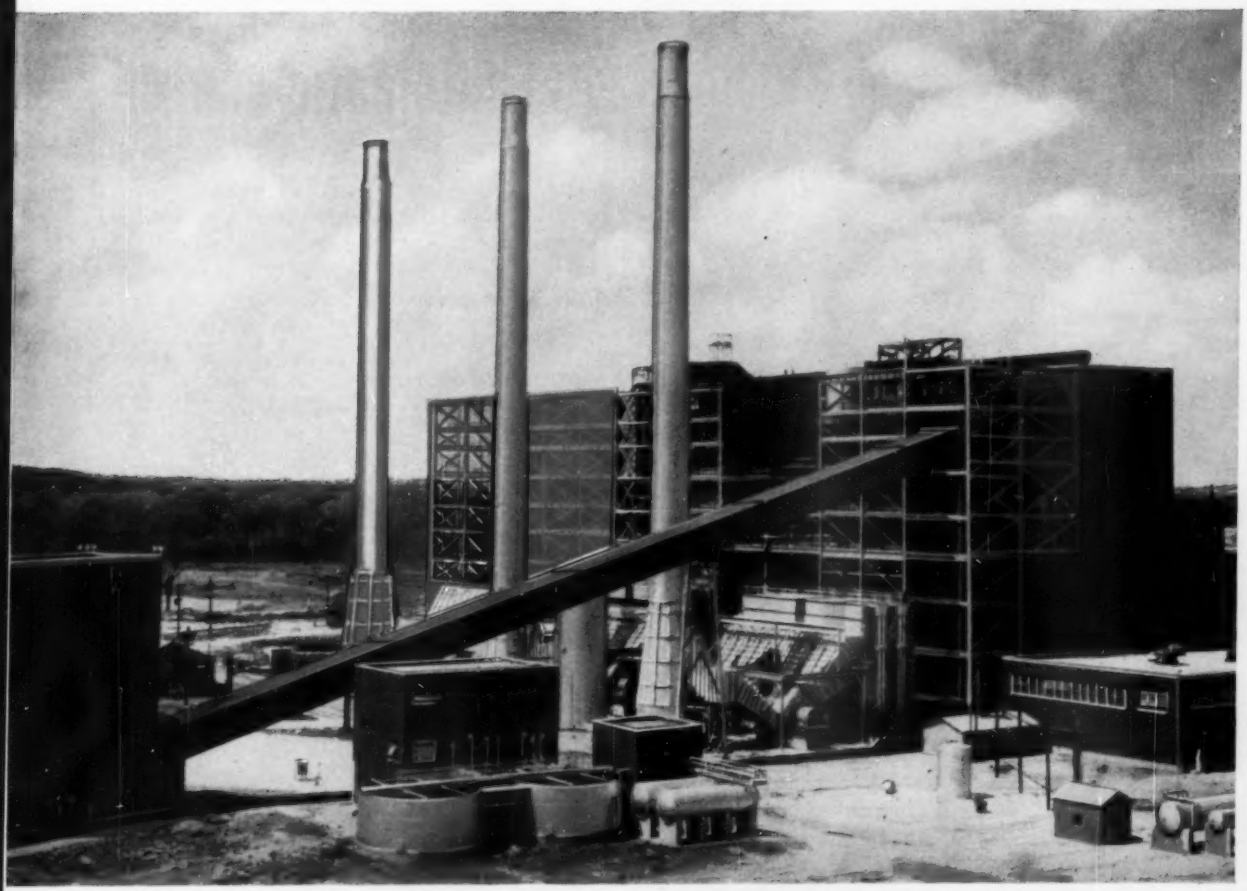
The proved dependability and long-range economy of Foster Wheeler steam generators are backed by more than 50 years of experience in pioneering power plant equipment. We will be pleased to quote on your requirements. *Foster Wheeler Corporation, 165 Broadway, New York 6, N. Y.*

STEAM GENERATORS
SURFACE CONDENSERS
FEEDWATER HEATERS
HEAT EXCHANGERS

FOSTER

NEW YORK • LONDON

1,850,000 lb steam per hr!



The above photograph of Union Electric's Meramec Station shows, in color, the new Unit No. 3 as it will appear when the addition is completed in 1958. With a capacity of 275,000 kw, Unit No. 3 will increase the total output of Meramec Station to 560,000 kw. keeping system capability well ahead of maximum anticipated load growth.

Reddy Kilowatt

*Trade mark character used by permission of Reddy Kilowatt, Inc.

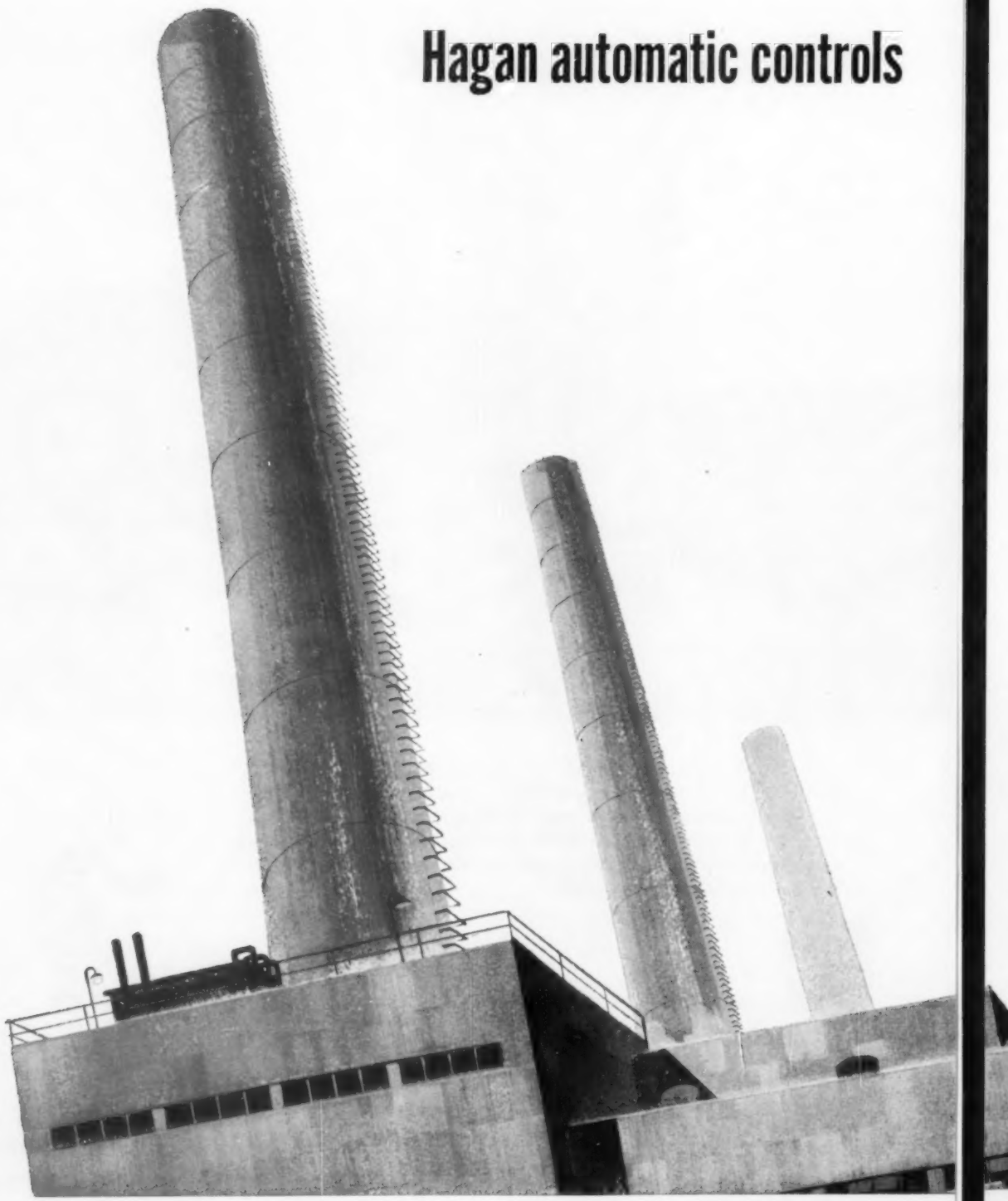
WHEELER

• PARIS • ST. CATHARINES, ONT.

ECONOMIZERS
BALL MILL PULVERIZERS
COOLING TOWERS

For more data circle 527 on Post Card

Hagan automatic controls



chosen for 5 of the largest boilers in the world!

Complete Hagan Automatic Control Systems have been chosen for 5 of the Largest Boilers in the World. Three different boiler manufacturers are represented in the Big Five, and the burners, pumps, fans, etc., are supplied by a variety of manufacturers. But take a look at the control systems for the Big Five:

	Boiler No. 1	Boiler No. 2	Boiler No. 3	Boiler No. 4	Boiler No. 5
Combustion Control	HAGAN	HAGAN	HAGAN	HAGAN	HAGAN
Three Element Feed Water Control	HAGAN	HAGAN	HAGAN	HAGAN	HAGAN
Reheat Control	HAGAN	HAGAN	HAGAN	HAGAN	HAGAN
Feedwater Pump By-Pass Control	HAGAN	HAGAN	HAGAN	HAGAN	HAGAN
Steam Temperature Control	HAGAN	HAGAN	HAGAN	X	X

It is natural that the Big Five chose complete Hagan instrumentation and control systems. For over 35 years, Hagan controls have paced each advance in boiler construction and size. The engineering know-how developed by the design and construction of automatic control systems for boilers of all types and sizes constitute one of the major reasons for Hagan's selection.

The Hagan instrumentation and control devices used in these systems are accurate, reliable and versatile. They are available to the power plant engineer as standard components for extension and modernization of existing facilities.

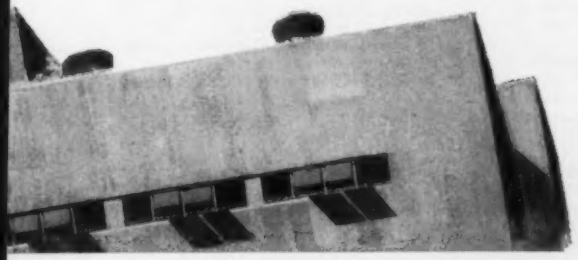
Hagan systems are in successful operation throughout the world. Call on your Hagan Engineer when you have an Automatic Combustion Control problem.

HAGAN CORPORATION

HAGAN BUILDING • PITTSBURGH 30, PA.

Systems and components for: Boiler Combustion Control, Process Control, Metallurgical Furnace Control, Aeronautical Testing Facilities • Industrial Water Treatment • Chemical Water Conditioning

Subsidiaries: HALL LABORATORIES, INC. • CALGON, INC.



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CONSTRUCTION NEWS

Mandalay Beach, Calif. — Southern California Edison Company, 601 West Fifth Street, Los Angeles, California, has announced plans for a 200,000-kw steam plant near Mandalay Beach, west of Oxnard. The unit will cost about $35,000,000 and will be one of the largest single units on the Edison system. Plans call for future expansion and a total investment in Ventura county of $75,000,000, which includes a station to relay the power from Mandalay Station.

Redondo Beach, Calif. — Southern California Edison Company, 601 West Fifth Street, Los Angeles, Calif., has authorized an appropriation of $7,400,000 for the construction of an additional steam electric generator, Unit No. 6, at its Redondo Beach Station No. 2; $2,000,000 for improvement and expansion of company substation at Los Angeles; $550,000 for additional and improved transmission lines at Long Beach; and $2,000,000 for enlarging and improving company's Delamo substation at North Long Beach, Calif.

San Diego, Calif. — San Diego Gas & Electric Company, 861 Sixth Avenue, San Diego, Calif., has plans under way for addition to steam electric generating station, including installation of new turbine generator, high pressure boiler and auxiliary equipment at company's Encina Plant No. 2. Cost reported about $10,565,000, with switching stations, transmission lines and other operating facilities. An additional $1,000,000 was authorized for new office building at same location.

San Francisco, Calif. — Pacific Gas & Electric Company, 245 Market Street, San Francisco, Calif., has tentative plans under way for addition to steam electric generating plant at Hunter's Point. A 165,000-kw generating unit will be added to three already installed bringing total capacity to exceed 425,000 kw. Upon installation of new unit to cost approximately $21,000,000 power station will be company's fourth largest.

San Francisco, Calif. — Pacific Gas & Electric Company, 245 Market Street, San Francisco, California, has received approval from the State Public Utilities Commission for the construction of five new hydroelectric power plants and the enlargement of another. This will provide 528,000 kw of additional generation. Projects are (new) Haas and Kings River and (enlargement) Balch power house, all on the North Fork of the Kings River and the Kings River in Fresno and generating 276,000 kw ($79,000,000); plus three new plants on the North Fork Feather River. Two new reservoirs will also be added, but are not intended to generate power. They are: Helms dam and reservoir (102,000 acre-feet capacity) and Wishon dam and reservoir (128,000 acre-feet capacity), both upstream from the Hass power house. New transmission lines will be added.

Hartford, Conn. — The Connecticut Light & Power Company, will expend about $20,000,000 extending into 1956, for expansion and improvements in company facilities. Vast improvements in power generating plants and system will be made, including additions to power substations and transmission lines.

Chicago, Ill. — Commonwealth Edison Company, has recently announced an expanded program for 1956 and proposes to expend in excess of $120,000,000 for new generating facilities, new transmission lines and distribution facilities, including modernization of its general plant facilities and equipment.

East Chicago, Indiana — Youngstown Sheet & Tube Company, Youngstown, Ohio, has announced an expansion program at company's Indiana Harbor Works, to include installation of a 25,000-kw, 11,000-volt hydrogen-cooled turbine generator and two 300,000-pound per hour high pressure boilers. Installation when completed will boost company's power capacity and will more than double the capacity of any of the six units now in operation. Work is expected to be completed prior to January 1957.

Baltimore, Maryland — Baltimore Gas and Electric Company, Baltimore, Maryland, has ordered a 125,000-kw, 3600-rpm, tandem compound, double-flow, reheat turbine generator for its Herbert A. Wagner Station in Greater Baltimore. Steam conditions are: 1800 psig, 1000 F, reheat 1000 F. The generator is rated at 160,000 kva. General Electric furnishes the turbine and generator.

Wyandotte, Mich. — Municipal Service Commission, Wyandotte, Mich., has authorized installation of new 22,000-kw steam turbine generating unit for increased capacity, including complete accessory equipment. Cost of power plant, four substations and surface condenser for generating unit to cost in excess of $1,200,000.

St. Paul, Minnesota — Northern States Power Company, 15 S. Fifth St., Minneapolis, Minn., has recently awarded a contract for the erection of super-structure for a 100,000-kw steam generating plant addition at company's High Bridge site near here. McGough Brothers, 1954 University Avenue, St. Paul, Minn., general Contractors. Total estimate to exceed $15,000,000.

Chillicothe, Mo. — City Council has authorized plans for expansion and improvement in municipal electric generating system and has disposed of a bond issue totaling $1,395,000 to cover cost of work to get under way soon.

St. Louis, Mo. — Union Electric Company of Missouri, 315 N. 12th Boulevard, has recently announced the purchase of a $35,000,000 dual circulation steam generator for Unit 3, at company's Meramec Plant. Foster Wheeler Corporation, 165 Broadway, New York 6, N. Y. engineer.

Ridgefield, N. J. — Public Service Electric and Gas Company, 80 Park Place, Newark 1, N. J., has announced plans for a new generating station on Overpeck Creek in Ridgefield, N. J. It will be called Bergen Station and will have two 275,000-kw units. The cost, including transmission facilities, will be about $129,000,000. Completion is scheduled for 1958.

Columbus, Nebraska — Consumers Public Power District of Nebraska, 1452 25th. Avenue, Columbus, Neb., plans 75,000-kw sodium cooled, graphite moderated nuclear power plant. Work will get under way in the near future and plant is expected to be completed in early 1959.

Beverly, Ohio — Ohio Power Company, 301 Cleveland Avenue, S. W., Canton, Ohio, has plans under way for new steam electric generating unit at Muskingum River Plant. Installation of Unit No. 4, will consist of a 225,000-kw turbine generator unit, high pressure boilers and auxiliary equipment. Installation will represent an investment of $28,000,000 and work on foundations will begin soon.

Clarington, Ohio — Ohio Power Company, 301 Cleveland Ave., S. W., Canton, Ohio, has announced the acquisition of 500 acres of land along the Ohio River, just north of here, for a site of a future 1,000,000-kw power plant. It is expected that actual construction of the plant will begin within the next two or three years and will represent an investment of well over $125,000,000. The plant will be located one mile north east of Clarington and about five miles downstream from Powhattan Point, Ohio.

New Richmond, Ohio — Cincinnati Gas & Electric Company, Fourth & Main Streets, Cincinnati, Ohio, has recently awarded contract for a new 156,250-kw turbine generator for Walter Beckjord Station installation. Total cost estimated in excess of $25,000,000.

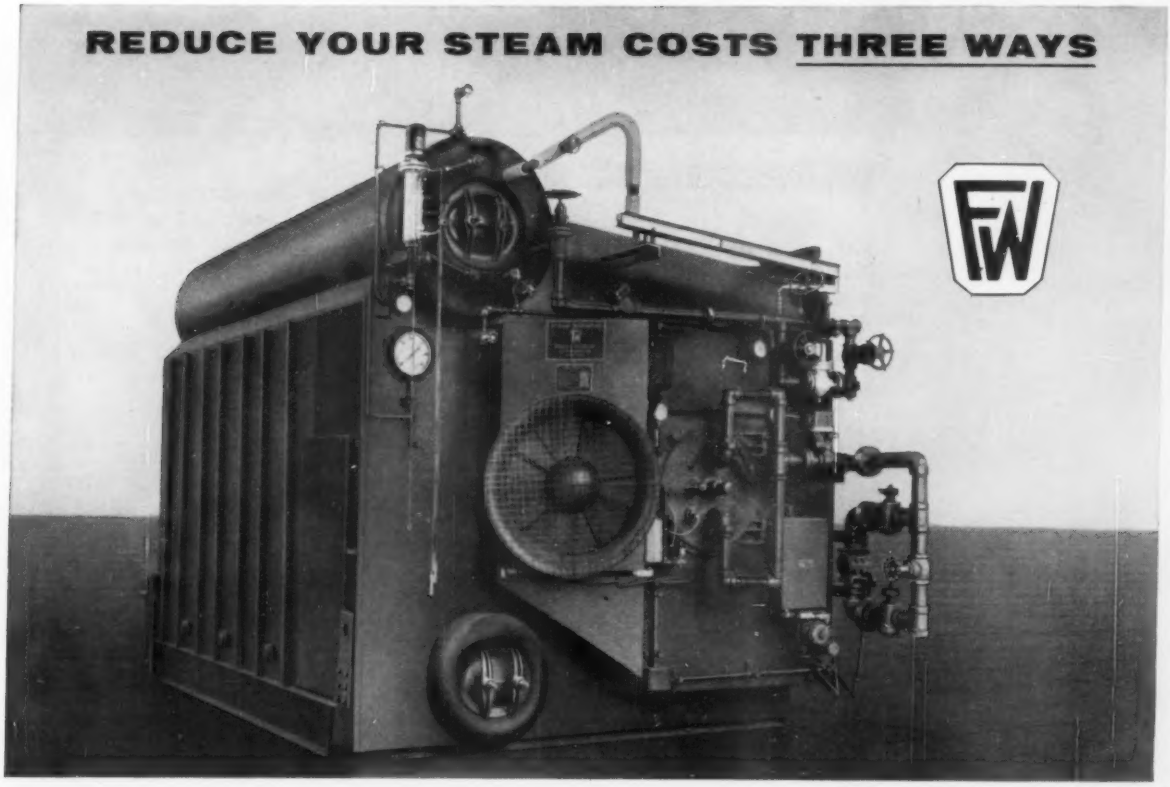
Newcastle, Pa. — Pennsylvania Power Company, 19 E. Washington St., New Castle, Pa., has authorized installation of a new turbine generator, on Unit number 4 at its New Castle plant. Westinghouse Electric Corp., Pittsburgh 30, Pa., engineer. Cost estimated when completed in excess of $2,500,000.

Kirk, So. Dakota — G & T Electric Co-operative, Rapid City, S. D., has tentative plans for the installation of a new 16,500-kw steam generating unit and substations facilities at Kirk. Cost of installation estimated at $3,500,000.

Yorktown, Va. — Virginia Electric & Power Company, Richmond, Va., has recently announced plans for the construction of a $20,000,000 power station on the York River, six miles east of Yorktown, Va. The plant will have an initial capacity of 165,000 kw and will use refinery by-product coke and gas as fuel from the adjacent plant of the American Oil Co. The boiler installation is capable of firing all three fuels at the same time or it can operate entirely on coal or with 85 per cent coke depending on the circumstances. Stone & Webster Engineering Company will design and construct the new steam power plant to be completed by late 1957.

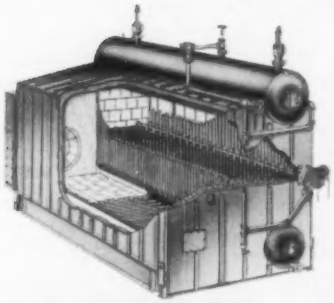
Washington, D. C. — Office of the Architect of the Capitol, U. S. Capitol, Washington, D. C., has recently awarded contract to the Standard Engineering Company, 2129 I St., N. W., Washington, D. C., for changes and improvements in the United States Capitol power plant.

REDUCE YOUR STEAM COSTS THREE WAYS



with the New Foster Wheeler

PACKAGED STEAM GENERATOR



CONSTRUCTION FEATURES

- 36" steam drum and 24" water drum
- Staggered boiler tube arrangements
- Closely spaced waterwall tubes
- Water cooled target wall
- No headers — Low circulation loss
- Light, highly efficient refractory and insulation
- Wide choice of burners and controls
- Baffled steam collector

You save on *first cost* because the FW unit is pre-engineered and shop fabricated from standard parts by the most modern, efficient and cost-saving production methods.

You cut *installation cost*, with a compact, space-saving unit that's shipped completely assembled — all ready to set on a simple foundation — all ready for your fuel, steam and electric connections.

You save *operating cost* all year 'round, because FW Packaged Steam Generators are designed for high sustained efficiency and exceptional ease of inspection and maintenance.

The NEW Foster Wheeler Packaged Steam Generators, in capacities from 10,000 to 46,000 lb/hr, represent the last word in modern steam plant design, reflecting more than 50 years of service to the power generation industry.

For complete details, send for Bulletin No. PG-55-3.
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EQUIPMENT NEWS

1—COAGULANT AIDS speed up water clarification

Designed to speed up water clarification processes, these coagulant aids make coagulants such as aluminum and iron compounds more efficient in removing turbidity from water. As explained by manufacturer, these aids cause flocs of aluminum or iron hydroxides, which enmesh finely divided sediment, to form more quickly and to settle more rapidly. They also make it possible to clarify raw water over a broader alkalinity or pH range than would otherwise be possible, company points out. Even without coagulants, the aids are said to help in the formation of larger, faster-settling precipitate in lime-soda softeners. Three compositions are available — No. 7, 11, and 18. Selection of aid to be used in a particular application depends on water quality and type of clarifier or softener. Coagulant aids have wide application in clarification and softening of raw waters for boiler feedwater and in treatment of industrial process waters. Hagan Corp.

2—VALVE, tight closing, for dead-end or full shut-off

Designed to meet the need for a tight-closing valve with good modulating characteristics, the Type MA is declared particularly applicable on medium and high pressure pipelines for difficult dead-end or complete shut-off service. While

engineered to avoid sticking and clogging, this valve has no tendency to chatter or rattle, says manufacturer, and has functioned quietly on pipelines with pressures to 250 psi. Available in sizes from ¾ to 2 in., the valve body is case bronze. Poppet, seat insert, pilot poppet and pilot seat are stainless steel and the stem is Monel. Sizes ¾ to 1½ in. have union ends; 2-in. size has flanged ends.

The MA Valve, which is piston balanced, contains a poppet that is directly operated by the valve stem, and hence is considered full modulating. According to company, maintenance of this valve is simplified by readily available replacement assemblies of: valve stem and pilot poppet; main poppet and pilot cage; seat insert and piston. Sylphon Div., Robertshaw-Fulton Controls Co.

Reader Service Cards on pages 115–116 make it easy to get further information on any of these products. Just circle the item numbers of the products you want to know more about.

3—THERMOSTAT solves some dirt and humidity problems

Temperature control in installations where dirt and humidity present a problem is claimed possible with this versatile thermostat, the L-37 spacestat. Featuring a mercury switch, all major components, including sensitive bimetal element, case and cover are made of stainless steel. Heavy-duty, light duty and millivolt models are suitable for general-purpose temperature control of heating, refrigeration, ventilation and processing equipment. Close temperature control is assured, company points out, through heat anticipation on heating models and cold anticipation on cooling models. Heavy duty model is supplied with dial lock and external adjustment knob. Light duty and millivolt models have external adjustment holes. Unit has two conduit knockouts for wiring. General Controls Co.

4—ALL-PURPOSE HOSE of horizontal braided construction

Allflex is described as suitable for use with air, oil, water and mild chemicals. The new hose is credited with offering several major advantages including long life and non-kinking. It is announced as newest addition to this manufacturer's line and the first all-purpose hose of mandrel-made horizontal braided construction. Complete information is given in Bulletin 7075. Manhattan Rubber Div., Raybestos-Manhattan, Inc.

5—VALVE POSITIONER uses motion balance principle

For precise control action, Type C Vernier Valvactor overcomes friction and reduces line effects, it is announced, speeding valve response to controller signal. Its applications include large-volume diaphragm motors and processes where controller-to-valve distances are long. A simple motion balance device, positioner receives a controller output signal at a spring-opposed bellows which governs a flapper-nozzle relationship. Back pressure in the nozzle circuit acts on a high capacity air relay to vary supply pressure to valve motor. Full pressure can be applied to motor on a controller output change of less than 2 in. of water. As valve stem moves to its correct position, a lever connected to stem rotates Valvactor shaft which, through a spring and ball arrangement, restores flapper-nozzle relationship to a point of balance. Extremely compact, positioner is only 6¾ by 6¼ by 5$\frac{5}{16}$ in. It mounts directly on valve yoke. Positioner can be adapted to either air-to-lift or air-to-lower diaphragm motor. The Foxboro Co.

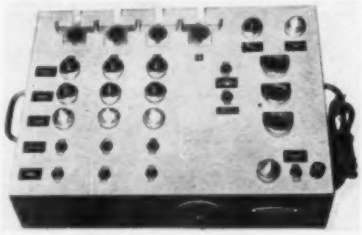
6—PIPE HANGERS with load capacities of 31 to 32267 lb

Incorporated in an extended line of Model R Constant Support Hangers are most sought for features in pipe suspension, says manufacturer. These hangers are designed to permit expansion and contraction of piping systems, through heating and cooling cycles, without developing dangerous stresses. As ex-

plained, this new line offers increased supporting forces or greater travel within a given frame size to provide any load or travel required. Capacities range from 31 to 32267 lb and there are nine frame structures available — two of them new. Field adjusting bolts have been relocated for easy load adjustment. Bearings have been relocated in the frames to permit the main pivot to rotate and carry the load indicating pointer. Four of the new designs require less headroom, permit use closer to other structures. Grinnell Co., Inc.

7—TESTING DEVICE checks annunciator systems

This compact testing device was developed to check the performance of plug-in relays and flashers employed in Panalarm annunciator systems, used to indicate off-normals in processing and supply information on cause-and-effect sequence of events. Portable testing device checks operation of Standard 50

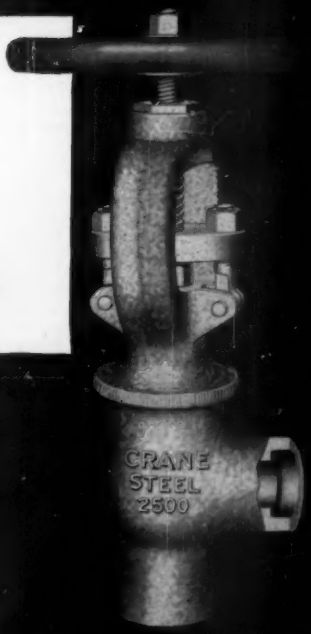


Series Panalarm relays and flashers, on location. It is adapted easily to the particular unit under test, company points out — all changes of internal circuitry are accomplished by a single rotary switch. Relays and flashers are plugged into device and an appropriate voltage is applied. Correct performance of all functions is indicated by lamp pattern

Why buy small high-pressure valves that lack these CRANE features?

New 1500 and 2500 pound check patterns . . . screwed or socket welding ends; ½" to 2". Patented construction assures high disc lift, free flow and minimum pressure drop.

1500 and 2500 pound globe patterns... screwed or socket welding ends; ½" to 2".



1500 and 2500 pound angle patterns... screwed or socket welding ends; ½" to 2".

When you buy CRANE Lip-Seal Bonnet Valves . . . designed exclusively for high pressure/high temperature power plant service . . . you are assured of:

- lip-seal welds that are laid on flat surfaces—needn't be chipped out or burned out;
- easy dismantling and reassembly—bonnet screws out after weld is *ground away*—makes inside of valves entirely accessible;
- bonnet threads are chrome plated to prevent galling or seizing;
- stems that do not bind or gall—because of CRANE's exclusive ball-joint glands;
- easy access to stuffing box—swing-type gland eye-bolts swing free of yoke area, can't be lost;
- a more rigid swivel disc-stem connection that minimizes vibration;
- each size valve is a separate design for proper proportion—another CRANE exclusive.

These features assure better small valve performance with important maintenance savings. Use Crane Lip-Seal on main and auxiliary steam . . . on boiler feed and blowdown lines . . . on drips, drains, by-passes, etc. Ask your local Crane Representative for circular AD-1902 on these valves, or write to address below for a copy.

CRANE VALVES & FITTINGS

PIPE • KITCHENS • PLUMBING • HEATING

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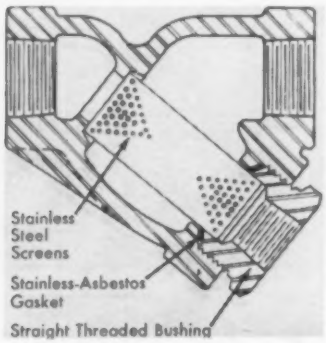
displayed on tester under its several switch settings. Tester has carrying handles and a plug-in power cord. Panellit, Inc.

8—GATE VALVE with cylindrical body neck

The redesigned No. 430, a 125-lb brass rising stem double wedge disc gate valve, is designed for general service on steam, water, oil and gas lines, and comes in sizes from ¼ in. through 3 in. Body neck in the model is cylindrical. This design offers maximum strength on body structure, it is pointed out, and eliminates need for massive wall sections. It affords a compact, relatively lightweight valve, says company, yet is ideal for resisting internal pressures. The cylindrical neck reinforces seat area against wedging of the disc and safeguards against distortion of the body in seating the disc. Sizes ½ in. and larger are fitted with double wedge type disc; sizes ¼ and ⅜ in. have solid wedge discs. All sizes feature slip-on type disc-stem connection. Valves ¾ in. and larger have a stuffing box gland. Crane Co.

9—PIPE STRAINERS, Y-type, for high temperatures, pressures

Six sizes of Y-type carbon moly steel strainers have been added to this manufacturer's line of cast semi-steel strainers. The new strainers are announced for oil, gas, air, water and steam lines, and suitable for pressures to 900 lb and temperatures to 900 F. Maximum pressure at 100 F is 1800 psig. The strainers come in ½- through 2-in. sizes, screwed or socket weld. Sizes 1¼ in. and larger have bolted retainer plates; smaller sizes have straight thread screwed bushings.



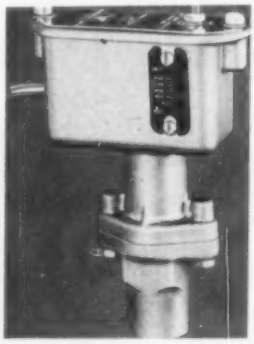
Stainless steel screens are standard, either 0.045-in. diam holes, 226 per sq in. or 24-by-110 wire mesh. Other screening material is available. Design features include a stainless-asbestos gasket, locked in between body and the base of the bushing to eliminate chance of blowout. List prices start at $13.00. Armstrong Machine Works.

10—CORROSION CONTROL for submerged metal surfaces

The Cath-O-Chem Method is especially intended for stopping corrosion of the submerged metal surfaces in fire protection water storage tanks. It combines cathodic protection with chemical treatment consisting of the addition of a particular dosage of specific non-oxidizing salts or colloidal substances to the water. This chemical treatment is claimed to greatly reduce initial installation cost and operating expense of cathodic protection. It is also said to assure a better and more consistent distribution of protective current to all of the submerged metal surfaces in the tank. Electro Rust-Proofing Corp.

11—PRESSURE SWITCH can be set visually without gages

Pressure Switch C9612 has a calibrated plate which enables visual setting of the switch before or after installation on a pressure line. An indicator inside the



switch is visible through a window in the plate. By means of an external adjustment screw, the indicator can be lined up with the desired pressure on the plate. Then, when the desired pressure is set, the screw can be locked in place. This switch is designed to sense any system pressure over an adjustable range of 15 to 3000 psi; the particular range may be covered by one of four classes of switch. The fixed actuation value varies from 10 to 250 psi, depending on setting. Barksdale Valves.

12—THERMOSTAT for hot water heater control

Accelerated life tests are reported to show that the Clostemp Thermostat can maintain water temperature to within 3 F of original calibration even after 50,000 operations — about 20 years of actual service life. For quick response to tank wall temperature change, the bimetal assembly has been placed on the outside of the thermostat back plate. Contacts and other current carrying parts are protected within an aluminum and molded phenolic case, 2⅜ by 2⅞ by 1⅜ in. in size. Other features include a reflective dial plus positive dial stops to prevent setting above a safe limit. Temperature is adjustable from 120 to 170 F. Westinghouse Electric Corp.

13—INSULATION WRAPPER of heavy cotton cloth

Vycot is designed to cover heat insulation on piping and protect it from deterioration by weathering, sunlight, moisture and chemical action. It is fabricated with a heavy weight cotton cloth heat treated with chemically resistant resins. The material is described as homogeneous and dimensionally stable for protecting insulation indoors and out. Being flexible, Vycot is easily handled and installed; company says it conforms to all sizes and shapes and offers an excellent vapor barrier to moisture, chemical fumes and spills. Its finish and resistance is also claimed unaffected by bacteriacide washes commonly used in hospitals and food processing plants. The material comes in standard colors of aluminum, red, gray, yellow and green, but special colors are available. Vycot can be sewn or cigarette wrapped around piping surfaces. A fast drying bonding cement is supplied by manufacturer for this purpose. Vycot comes in 75-yd rolls, 54-in. wide. The Industrial Laminates Div., Fabric Distributing Co.

14—POROUS FILTER is made of sintered stainless steel

Poro-Klean Filters make it possible to filter under severe conditions, it is announced, with temperatures up to 1200 F, differential pressures of 2000 psi, and corrosive liquids or gases. Physical properties of Poro-Klean elements are: tensile strength (ultimate) 9000 to 25,000 psi, per cent of elongation (ductility) 3 to 6 per cent, and per cent of porosity 30 to 50 per cent. Particle size retention grades from 3 to 30 microns. In this line of sintered stainless steel filters, standard elements are designed to fit production line housings. Elements are either cylindrical or cell type and respective filter areas are 0.6 sq ft and 2 sq ft. Choice between two elements is dictated by operating conditions for each application. For unusual conditions custom engineered filters can be ordered. The Cuno Engineering Corp.

15—DUAL-ELEMENT FUSES, with controlled time-lag

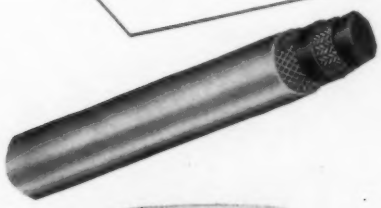
Econ Dual-Element Fuses, for applications in which long and controlled blowing time is desired, incorporate company's Econ-Alloy thermal element for improved circuit protection. Econ-Alloy has a precise melting point, and as it is heated, maintains its shape and strength until becoming liquid. With motors and other circuits where overloads are likely

to occur, the fuses serve to eliminate unnecessary blowouts. This protection extends up to 500 per cent overloads, company notes, with provision for immediate blowout on short circuits. Additional advantages announced are protection against single phasing, elimination of need for overfusing, and assurance of cooler-operating fuse boxes and panels, with consequent reduction of fire hazards.

Range of sizes is 0 to 600 amp in both 250 to 650 v, in ferrule and knife-blade types. Design and construction varies slightly, to suit various sizes. On ferrule type 0 to 7 amp, a coiled thermal element

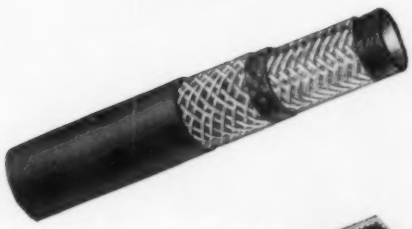
For long, trouble-free service . . .

use Quaker hose



AIR Extra lightweight, highly flexible hose for heavy duty work. Resists weather damage and abrasion. Non-porous tube of oil resistant rubber compound. Rugged Neoprene cover. Ideal for almost any hose installation.

FIRE Resilient, flat-folding hose saves space and gives long service in interior fire protection. Highly flexible and resistant to cracking. Leak-proof tube bonded to strong single jacket cover. Recommended for institutions, offices, ships, etc.



STEAM Many times stronger than wrapped fabric hose for general steam-handling jobs. Also lighter, more flexible and kinkproof for easier handling. Steel wire and glass reinforcing insures extra safety. Resists high pressures up to 388° F.

WELDING No twisted, tangled lines. Two lines are securely bonded together to form a single, safe hose unit. Kink-free and resistant to welding gases. Stands up to lots of dragging across rough surfaces. Especially effective on portable welding dollies.

WATER For long wear and outstanding value, this easy-to-handle hose has what you need. Reinforced with multiple plies of high tensile yarn, it takes higher than usual working pressures. Cover stands up to weather extremes without cracking or peeling.

Save time and money. Call your Quaker-Quaker Pioneer distributor first, when you need hose or other industrial rubber products. You'll find him prompt, dependable.

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inside a brass heat-conduction sleeve insulated by a ceramic sleeve, actuates overload element. On the 8 to 60 amp, 250 v; and the 8 to 30 amp, 600 v, fusible links are used. On all knife blade sizes and on 35 to 60 amp, 600 v, ferrule sizes, two fusible links are bonded to time-lag element. Economy Fuse & Mfg. Co.

16—DIAPHRAGM VALVE offers straight-through flow

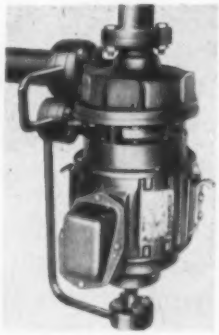
The Grinnell-Saunders Straightway Diaphragm Valve is designed to offer the extra advantages of straight-through flow for handling viscous materials, fibrous slurries, sludges, semi-fluids and solids in suspension. Attributed to the Straight-way feature are: ability to handle viscous material without restriction or stoppage; minimum pressure drop; rodding or brushing without removing valve bonnet and without possible damage to body linings; and self-drainage when pipe line is pitched sufficiently to drain the piping. This valve retains advantages of company's weir type diaphragm valve, it is pointed out, including positive closure even when handling gritty or fibrous materials. Saunders Valve Dept., Grinnell Co., Inc.

17—SAFETY HEADGEAR with adjustable, floating headband

Adjustable to head sizes from 6½ to 8, the Supergard is available as hat or cap. It is molded from a flame-retardant waterproof material in seven colors: red, yellow, blue, white, grey, green, and brown. It meets government specifications, says company, and size adjustments are accomplished without lacing. Both hat and cap are fitted with a plastic cradle — only the sweatband need be replaced when transferring the hat or cap from one person to another. The Boyer-Campbell Co.

19—CENTRIFUGAL PUMP for use where leakage isn't permitted

Two lines of leakless general purpose centrifugal pumps — the Electri-Cand — are announced for handling precious or hazardous liquids where no leakage is permitted. The pumps come in a fractional horsepower line (C-10) to include



motors through 2 hp, and an integral horsepower line (C-11A and C11-B) covering motors above 2 hp. They accommodate heads to 250 ft and temperatures to 250 F and can be had with capacities to 500 gpm. The Electri-Cand utilizes the canned motor principle in which the rotor of the driving induction motor rotates in the fluid being pumped and is connected directly to the pump impeller. This construction requires no packing or mechanical seals, it is noted, and all rotating elements of pump and motor are contained in a thin wall cylinder or "can".

The Type C-11A integral horsepower models have fluid piston bearings throughout, which are supplied with liquid through an internal connection with the pump casing discharge nozzle. The liquid is forced through the bearing piping to the bearings, pressuring the bearing pads. The pressure, which is self-adjusting, keeps the shaft centered in the bearing. Leakage from bearing is collected and returned to pump suction.

Construction of the C-11B model is similar, except that external piping is eliminated and less costly carbon sleeve radial bearings are used. There is some circulation of the liquid to wet the bearings and to flush out any solids. Elimination of the bearing piping makes it possible to replace stators without opening the system. The fractional horsepower pumps have only carbon sleeve radial and thrust bearings. Pumps for any applications within the range of the two lines can be tailor made from standard parts. Allis-Chalmers Mfg. Co.

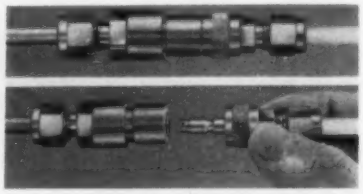
20—GAGE COLUMN for use in refrigeration systems

This low temperature gage, designed for refrigeration systems, is announced as consisting of a series of company's Level-Eyes which will not frost over or become fouled by oil or dirt. Liquid behind bull's eyes appears black, the absence of liquid leaves the glass clear. Boiling liquid does not affect the reading. According to manufacturer, the column is compact and easy to insulate — only the Level-Eyes must be left un-

covered. A transparent plastic frost-shield may be inserted over the Level-Eyes for very low temperatures. Column is suitable for use between −50 and 250 F, and at working pressures to 300 psig. It can be supplied at any practical length with Level-Eyes spaced as close as every 2 in. It is furnished complete with shut-off valves and ½ in. ball check valves. H. A. Phillips & Co.

21—FITTING is quickly connected and disconnected

Only tools needed to connect and disconnect the Swagelok Quick Connect Fitting are a thumb and finger, says manufacturer, and the shutoff valve incorporated acts as a seal to prevent leakage



during the operation. The fitting's internal design allows freer flow than possible with many fittings, it is claimed, and its exterior presents a slim, streamlined appearance. Used with plastic and metal tubing, the fitting is available in various metals, in sizes to fit ordinary applications and in three types: tube to tube with Swagelok ends; tube to pipe with one Swagelok end; bulkhead, either tube to tube or tube to pipe. Crawford Fitting Co.

22—PANEL CONTROL for automatic burners

Fireye AC Panel Control Systems offer complete burner protection, it is announced, and fully automatic operation for commercial-industrial oil, gas, and combination oil gas burners. In these

18—STEAM GENERATOR is field erected, headerless type unit

Offering capacities from 50,000 to 150,000 lb of steam per hour, these generators are announced as more compact, lower in initial cost, and easier and less expensive to maintain. Units can be built for pressurized or balanced draft firing, and heat recovery for higher efficiencies and superheat equipment can be provided. Superheater headers and steam temperature control lines are on the outside of the unit for ready access, and are drainable.

The design consists of a two-drum, bottom supported boiler with water cooled furnace having tangent tube spacing on bottom, both sides and roof, and a wider tube spacing in the front wall to permit burner installation with a tile backed-up target wall opposite the burners. This target wall is tube cooled with wall tube spacing arranged so that these tubes form a furnace screen ahead of the superheater.

There are no waterwall and no boiler headers. Water-steam friction losses are reportedly reduced to less than a fourth that of many designs. Thus, it is explained, virtually all hydrostatic head is available to support rapid circulation. This adds to the washing and cleaning effect provided by high velocity water inside the tubes. Installations are self-draining. Units can be provided with steam temperature control of either submerged heat exchanger type or spray type. The top drum of the unit has a steam purifier.

Because the unit is bottom supported, structural members have low unit stresses, company points out; and contributing to ease of maintenance is the fact that any tube within the unit can be replaced without removing any other tube, merely by removing panel sections from the casing. Separation of pressure parts from setting enclosure and use of tube joints with a specific grooving and tube seat depth on the water side of the drums, together with continuous tube design are claimed to make this type of generator a quick starter and quick steamer. It is also declared suitable for quick chemical cleaning applications. Springfield Boiler Co.

How to Select an Economical Temperature Regulator

First of all, what does *economy* mean where temperature regulators are concerned? In some industries it means improvement of product or reduction of spoilage through closer control of process temperatures. In others, it means the paring down of operating expense. The price of the regulator itself is a relatively small factor.

Today's buyers are shopping for:

1. Accuracy of control — not only when the regulator is new, but throughout its service life
2. Dependability — to prevent loss of production time
3. Minimum installation and maintenance cost

Here are a few tips on what to look for when you're installing a new or replacing an old temperature regulator —

Packless construction . . . and for this reason: A diaphragm operated, packless regulator minimizes friction. There are no closely fitted parts to stick or bind because of uneven expansion or collection of foreign matter. Also, there's less maintenance, since no repacking is ever required.

A guarantee against wire drawing of the seats and discs. Insist on it. This guarantee in combination with single seat design assures you of tight shutoff; you avoid expensive steam losses as well as loss of product in a process application.

Broad control range. In a standard regulator you should expect a control range of 100 F. And make sure the unit you select has a vapor tension thermostat that can take over-temperatures of at least 100 F.

Easy maintenance. Why ask for grief? Your temperature regulator should be basically simple in design so that it can be serviced by average plant personnel. All parts should be readily accessible for testing and cleaning.

Double duty. There's no point in buying a separate pressure regulator when you can select a temperature regulator that combines both temperature and pressure control within the same unit.

Self-operating. Make sure you get a regulator that operates on its own initial pressure. By doing so, you avoid the purchasing and maintenance of an air compressor plus air piping, and you're sure of uninterrupted operation during electric power failures.

• • • •

All of these points are important to you when it comes to selecting an economical temperature regulator. Perhaps you didn't realize you *could* expect so much. And perhaps you didn't realize that Spence Temperature Regulators offer all these features and more. May we send you our Bulletin T 500 containing further details? SE 156

SPENCE ENGINEERING COMPANY, INC.
Walden, New York

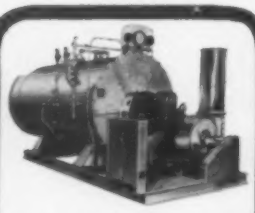
For more data circle 532 on Post Card

THERMOPAK

Cuts Installation and Operating Costs of Your Present Boilers

Next best to Preferred's famous induced draft Unit Steam Generator is the Thermopak—a truly complete, fully automatic combustion system which your own maintenance staff can easily install in your present boiler, without need of outside help.

The Thermopak is not a conventional oil or gas burner but an integrated unit, field surveyed, completely factory engineered, assembled and tested, with all controls and accessories on a single base, ready for fuel piping and electrical connections. There are no divided responsibilities or multiple contracts for installation of separate parts on the job.



For new boiler rooms or for added steam capacity—your BEST bet is a Preferred Unit Steam Generator — BEST of all "packaged" boilers in design, construction and operating economy. Built in 19 sizes from 20 to 600 B.H.P. 15 to 250 p.s.i., for oil, gas or combination fuels; factory fire-tested before shipment. Get Bulletin 2000.

Because of its unique design and method of preheating secondary combustion air, the Thermopak operates with very high combustion efficiency, far in excess of standard burner performance. Maintenance, fuel and operating costs consequently are less.

The Thermopak burns any grade of oil, gas or in combination; it is suitable for fire- or water-tube boilers of 20 to 525 B.H.P.

Investigate Thermopak's possibilities for improving your boiler's operation. Write for Bulletin 185 to Dept. PE.

PREFERRED UTILITIES MANUFACTURING CORP.

1860 Broadway, New York 23, N. Y.

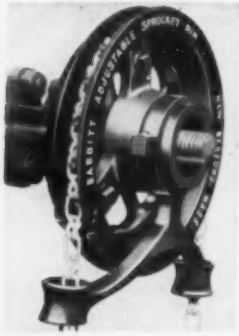
For more data circle 533 on Post Card

systems, flame failure safeguard, programming control, short-circuit protection, motor starters, fuel selector switches, signals and alarms, are combined in a single, integrated, pre-wired panel unit. Optional equipment available in panel assembly, includes sequence draft controls, draft and temperature indicators, and provision for switching to modulated, or fixed-rate firing.

According to company, these pre-assembled panel systems reduce installation cost as well as service charges. The systems employ flame-sensitive Firetron cell to visually monitor oil and gas flames. They are designed to automatically safeguard every stage of burner operation — purging, proving pilot, limiting trial-for-ignition to a safe period, shutting off fuel within 2 to 4 sec if flame goes out while firing. Combustion Control Div., Electronics Corp. of America.

23—SPROCKET RIM for added strength and utility

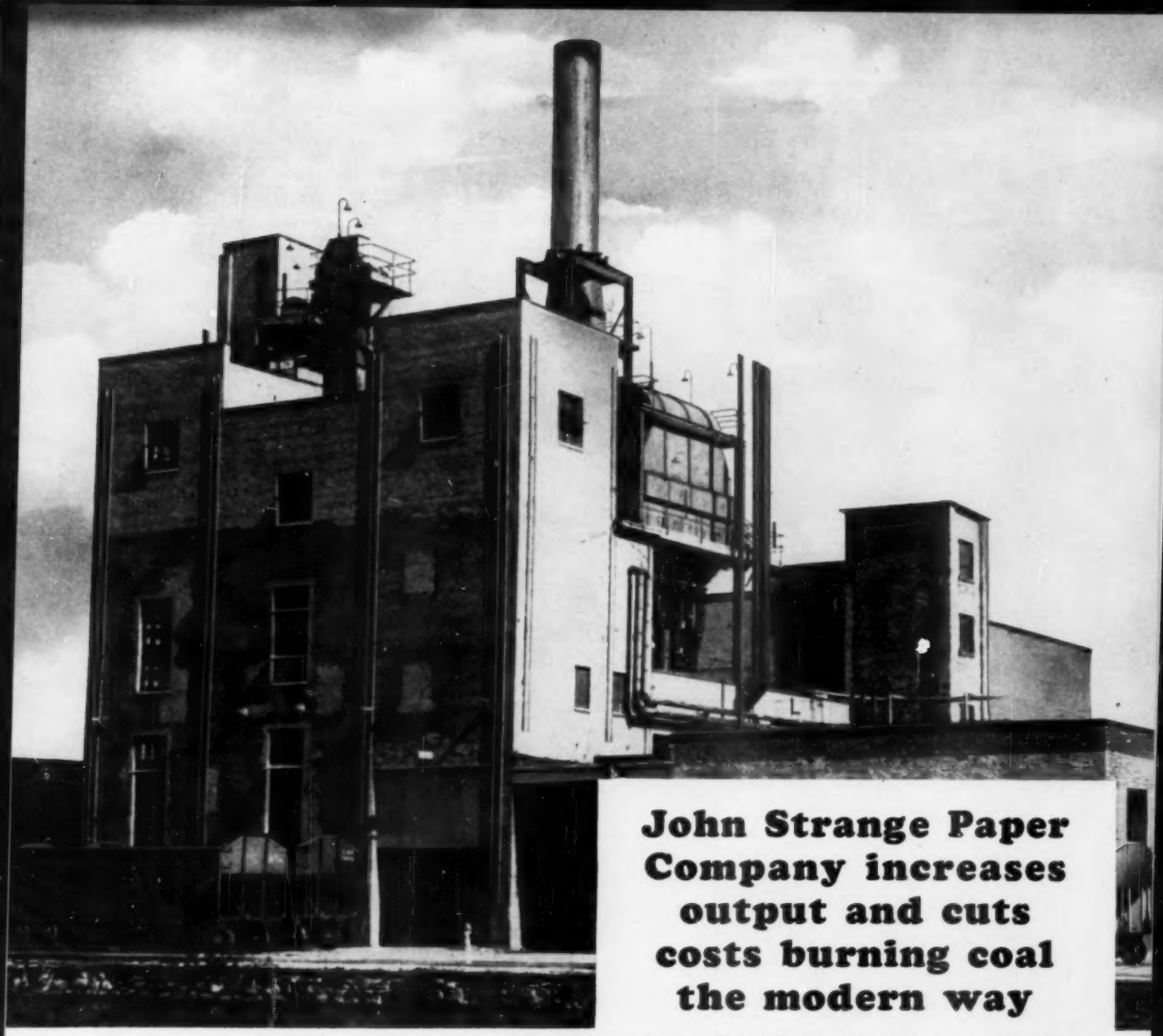
In this company's re-designed adjustable sprocket rim with chain guide, spider and rim have been incorporated into one casting. This simplified construction facilitates installation, it is noted, and at the same time contributes greater



strength to the unit. Installation is said to be simple and quick. Rim is designed to be used wherever inaccessible valves require chain wheel operation, where valve wheels control flow of steam, water, gas, oil and other materials, as well as on hoppers, chute gates, sluices, silos, high-up windows and skylights. Response is said to be quicker in valve opening and closing than with direct hand-on-wheel operation, because a continuous pull on sprocket chain eliminates waste motion. Rims are available in ten adjustable sizes to fit valve wheels 2 to 30 in. diam. According to manufacturer, all valve makes, with rising or non-rising stems, are accommodated. Babbitt Steam Specialty Co.

24—EXPANSION JOINTS for pneumatic handling systems

Of simple design, these expansion joints are reported to provide long-wearing, air-tight connections for long pipelines. They are made for 4-, 5-, 6- and 8-in. ID Ashcolite pipe and Class C and D cast iron pipe, and are designed to accommodate axial expansions up to 1½ in. per joint. The peripheral fitting of expansion joint sleeves over pipe ends minimizes wear by removing the entire assembly from the flow of materials, it is noted; a tight seal is assured by two inner-sleeve piston rings riding on outer sleeve.



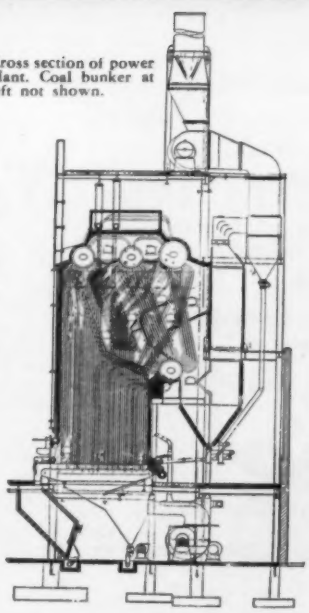
John Strange Paper Company increases output and cuts costs burning coal the modern way

Steam and electric power represents a considerable percentage of overall costs in paper mill production. In addition to this cost problem, the power plant of the John Strange Paper Co., Menasha, Wis., lacked sufficient capacity to meet the mill's demand for steam and power.

In an effort to trim costs and increase capacity, the company called in the consulting firm of Cummins & Barnard, Inc., Ann Arbor, Mich., to recommend a modernization program. Based on those recommendations, today John Strange burns coal in highly efficient steam-generating equipment. The remodeled installation includes completely modern coal-handling and pneumatic ash-handling equipment as well as two automatic control systems. Costs have been curtailed; steam and power supply is dependable. Most important, the mill machinery operates at higher speed, resulting in a 10% increase in production.

For further information or additional case histories showing how other plants have saved money burning coal, write to the address below.

NATIONAL COAL ASSOCIATION
Southern Building, Washington 5, D. C.



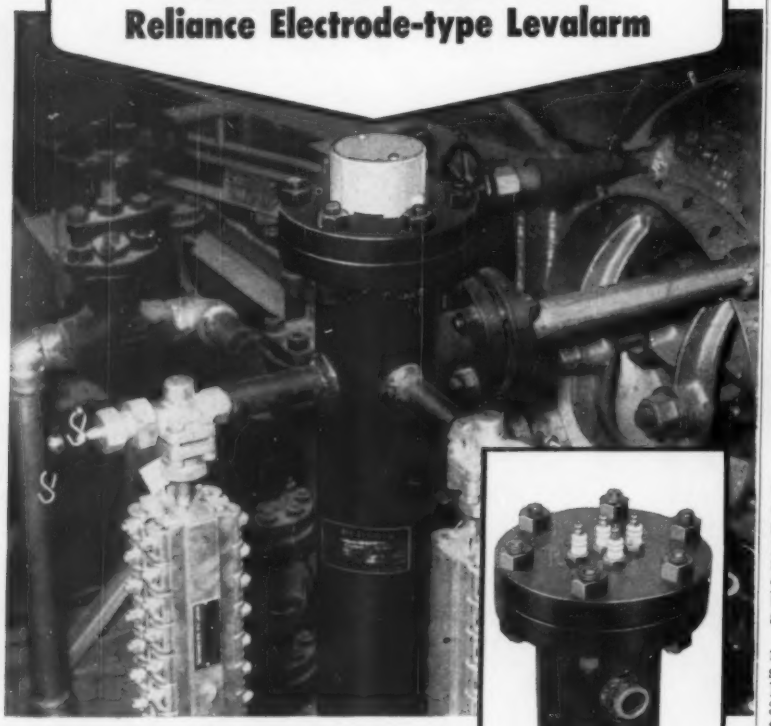
Cross section of power plant. Coal bunker at left not shown.

facts you should know about coal

In most industrial areas, bituminous coal is the lowest-cost fuel available • Up-to-date coal burning equipment can give you 10% to 40% more steam per dollar • Automatic coal and ash handling systems can cut your labor cost to a minimum • Coal is the safest fuel to store and use • No smoke or dust problems when coal is burned with modern equipment • Between America's vast coal reserves and mechanized coal production methods, you can count on coal being plentiful and its price remaining stable.

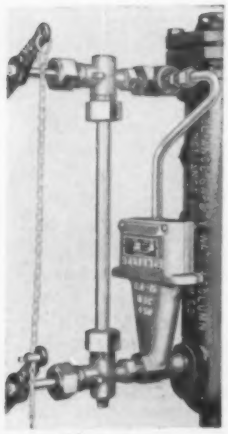
For more data circle 534 on Post Card

Small Device Does Big Job!
Here's all that shows of the Reliance Electrode-type Levalarm



Cap removed showing electrode connection fittings

Boiler water connects own alarm system and fuel cut-out . . .



Isolated circuits make relays work for you to actuate...

low water alarm — pump start
high water alarm — pump stop
fuel cut-out

(or selection of these facilities)

Upper photograph — Levalarm for pressures up to 2500 psi.

Lower photograph — Fuel cut-out Levalarm on water column. Can be installed in field.

Write for Bulletin D2.

The Reliance Gauge Column Company
5902 Carnegie Avenue • Cleveland 3, Ohio

The name that introduced safety water columns....in 1884

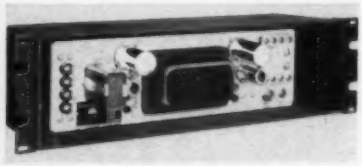
Reliance®
BOILER SAFETY DEVICES

For more data circle 535 on Post Card

Installation of these joints is claimed relatively easy; they attach directly to plain-end pipe without adapters or preparation. Sleeves are secured to pipe ends by cup point setscrews. Dog point setscrews in the outer sleeve act as guide in positioning the assembly during installation and keep the joint from pulling apart. Joints are shipped assembled. The Allen-Sherman-Hoff Co.

25—POTENTIOMETER, transmitting, features simple circuitry

Announced as having the simplest possible circuitry, the American-Microsen Transmitting Potentiometer has only two vacuum tubes. It is designed to permit measurement and control of low voltage while drawing negligible current from the source. It is available as a



thermocouple pyrometer or to measure d-c output of electrical transducers. No slidewires, batteries, standard cell, chopper or converter are used — input voltage is automatically balanced against output signal by company's Microsen balance, which also serves to maintain a constant reference voltage supply.

The unit comes in ranges from 6 to 50 millivolts (200 F and up), with zero suppression up to five times the span. High sensitivity — reported better than 3 microvolts — permits accurate control of temperatures, company notes, when used with electronic control system. An output of 0.5 to 5.0 milliamperes d-c is produced, which can be transmitted over distances up to 30 miles. Manning, Maxwell & Moore, Inc.

Described on these pages are new and improved products. Use Reader Service Cards on pages 115–116 to ask for more information on them. Just circle the item numbers of all the products in which you are interested.

26—VALVE ACTUATOR for electronic control systems

This self-contained electro-hydraulic valve actuator is said to increase advantages and utility of electronic control systems. Application of electronic control systems to industrial processes has been limited by conversion problems and equipment complexities needed to operate final control element. It is noted that with most electronic control systems, measurements are converted to electrical signals and fed into electronic amplifiers with proportional band, reset and rate actions. The electrical output signal of the electronic controller is then converted to a controlled air pressure which in turn operates a diaphragm actuated control valve. This valve actuator applies the electrical output direct to the final control element. The actuator is described

BREECHINGS · STACKS

AIR AND GAS DUCTS

PLATE FABRICATION FOR POWER PLANTS

KIRK & BLUM
FABRICATION

Whatever your requirements in fabricated plate, sheet or structurals for power plant use . . . call on experts!

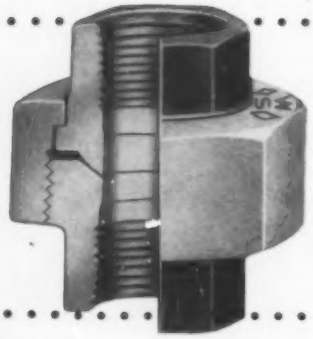
Kirk & Blum has fabricated a variety of power plant needs as big as the mammoth breeching section shown here. In a 150,000 sq. ft. plant, with crane capacity to 25 tons, Kirk & Blum has complete facilities to produce, pre-assemble and load the largest fabrication. Kirk & Blum has the men, materials and experience to do the job quickly and economically.

For detailed literature, write: The Kirk & Blum Mfg. Co.
3230 Forrer St., Cincinnati 9, Ohio

For more data circle 536 on Post Card

W-S FORGED STEEL UNIONS...

These Features are YOUR GUARANTEE of a Safe, Tight Union Connection:



1. FORGED STEEL CONSTRUCTION— ASTM A-105, GRADE 2
2. SPHERICAL-TO-ANGLE MATING SURFACES
3. ANTI-GALLING, CADMIUM-PLATED NUTS

W-S Forged Steel Unions give you the kind of protection you need in high pressure piping systems. They're designed with precision-machined spherical-to-angle mating surfaces for positive seating, free from leaks even when pipes are slightly out of line. Cadmium-plated nuts resist galling and seizing and forged steel construction gives you the extra strength you need in high pressure service.

W-S Unions are available in 3000 lb. class, sizes ⅛" to 3" in screw-end and socket-welding types. Send today for your copy of Bulletin U-1.

Sold Through Leading Distributors.

W-S FITTINGS DIVISION

H. K. PORTER COMPANY, INC.
Roselle, New Jersey

For more data circle 537 on Post Card

as a self-contained unit including control valve, hydraulic power source, and proportional positioning mechanism which can be used with existing electronic controllers. Outside connections consist of signal wires from the controller and an electric power supply. The signal current is applied to a high-resistance coil (3000 ohms or more) which moves in a magnetic field. Linked to the coil is company's Jet Pipe which converts an electrical signal of less than 50 milliwatts into the stroke of a control valve. The valve moves at a speed of better than 1 in. per second. Thrusts of 600 lb and more can be handled. Askania Regulator Co.

27—CENTRIFUGAL SEPARATOR for industries with dust problems

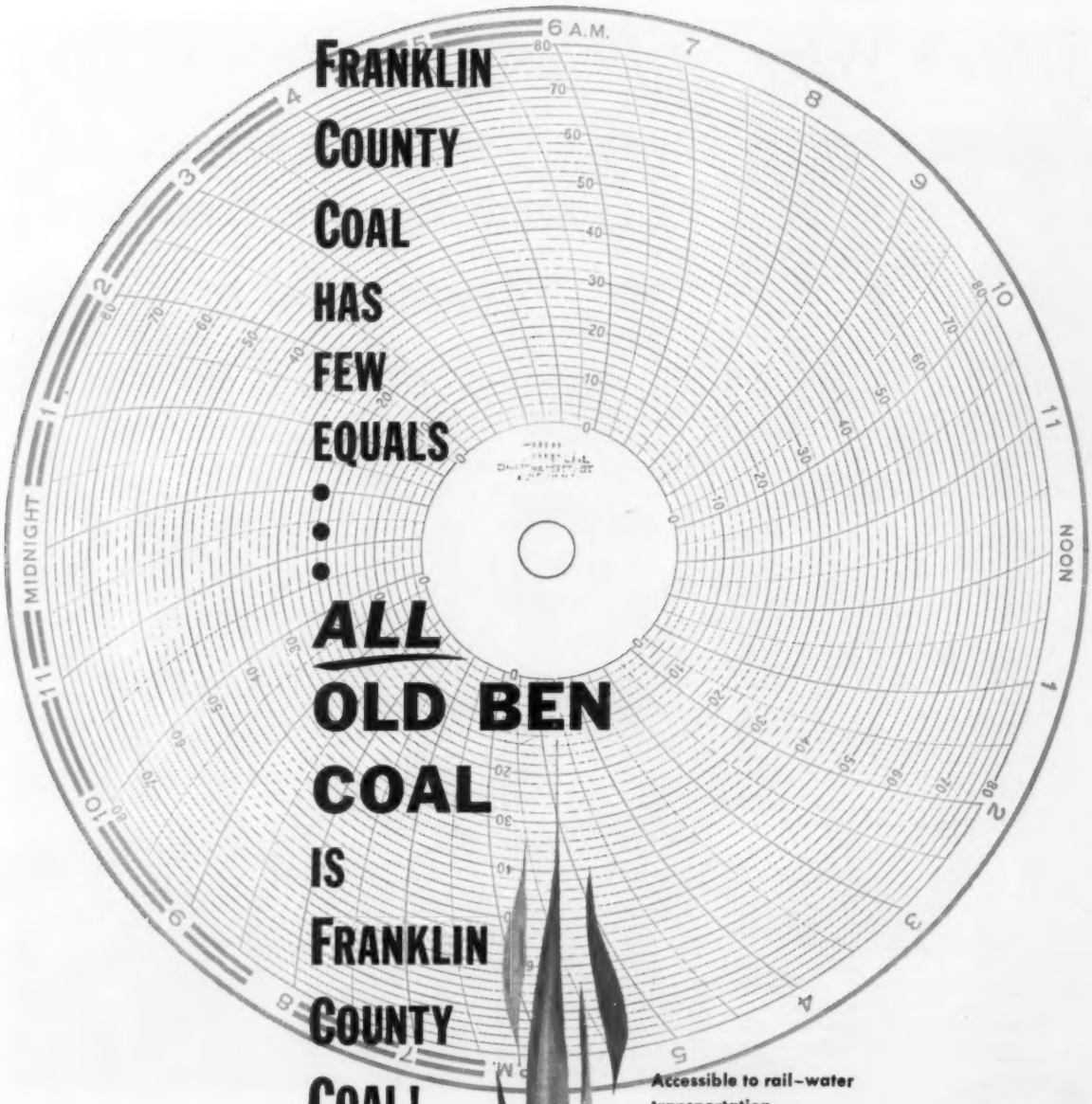
This multi-tube collector consists of an inlet chamber connected directly to a nest of vertically-mounted separating tubes, a dust-collecting hopper, and a clean gas discharge chamber. According to company engineers the design of inlet head and guide vanes make this collector different from other types and accounts for high separation efficiency. Dust laden gases enter the collector at velocities sufficient to keep fine dust particles suspended. Cleaned gas goes out the stack, it is explained, and practically all dust stays in the hopper.

Shape of inlet head and design of the guide vanes of each collector cause the gas to whirl in the space between inner and outer shell of the tube, throwing out more of the trapped dust particles. The cleaned gas, still whirling, flows down along the length of the tube and then moves up and out through the inner shell. Dust particles, forced to the outer shell by this action, flow downward and are discharged into the collecting hopper. In the initial installation of this collector — for fly ash removal from a pulverized coal-fired boiler — efficiency of 97 per cent is reported. In addition to this type of use, the collector is suggested for recovery of any process dust. Hagan Corp.

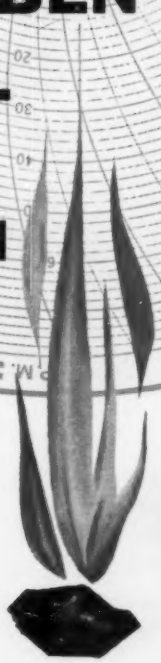
28—TEMPLATE lets you draw broken line combinations quickly

This template enables a draftsman to draw dot and dash lines with a rapid stroke of a pencil or ball-point pen. Produced for making piping drawings, the template is reported applicable to

any type of drawing where various broken-line combinations are desired. Six different line combinations can be produced: long dash, short dash, long dash and dot, long dash and two dots, and short dash and two dots. The hardness of the pencil determines the density of the line. Of transparent plastic, the template is used by placing a straight edge on the desired stencil and drawing the line. It costs less than $1.50, including mailing charge. dot-N-dasher.



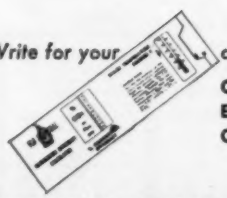
FRANKLIN COUNTY COAL HAS FEW EQUALS . . . ALL OLD BEN COAL IS FRANKLIN COUNTY COAL!



Accessible to rail–water transportation . . .

OLD BEN COAL

. . . Wherever Heat, Light or Power is Needed



Write for your *complimentary*
COMBUSTION EFFICIENCY CALCULATOR

OLD BEN COAL CORPORATION • CHICAGO 4, ILLINOIS

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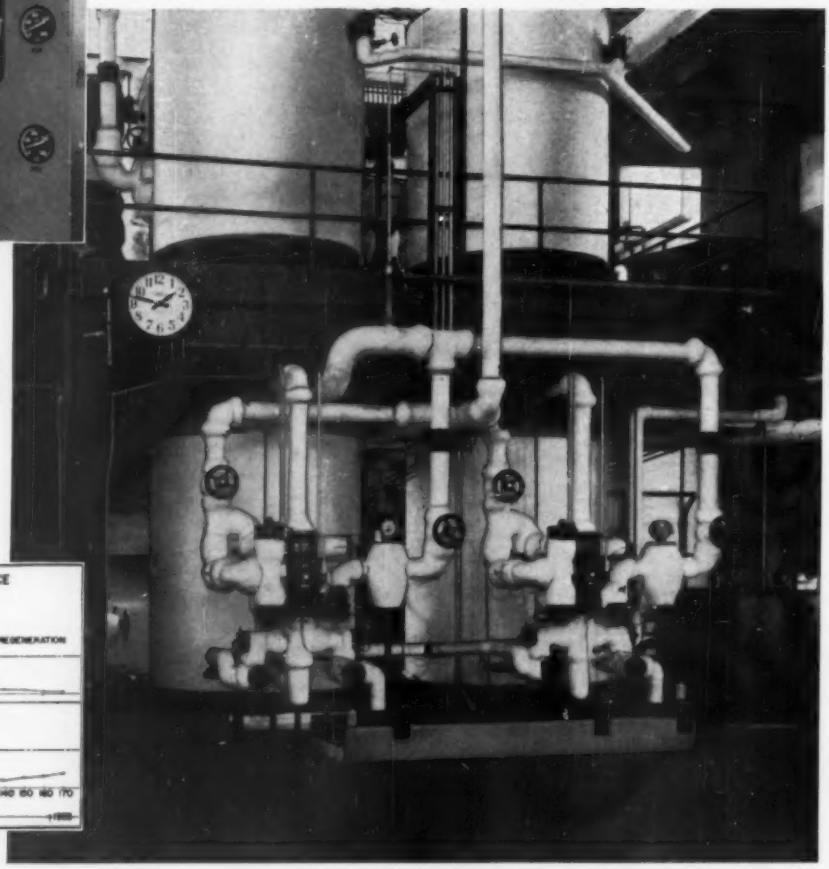
Here's Why Utilities Can Depend on

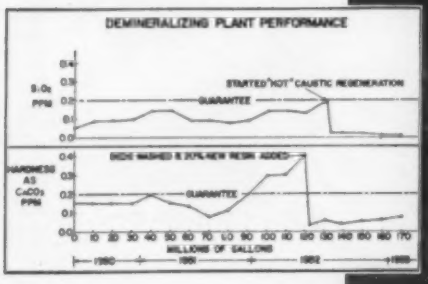
CATEXER® ANEXER®
DEMINERALIZATION PLANTS

Control panel designed and assembled by INFILCO



Waukegan Station Demineralization Plant

"CATEXER" "ANEXER" Demineralization Plant performance charts at Waukegan Station.



Five years ago, INFILCO pioneered the first large scale use of demineralization and silica removal by ion exchange for makeup to high pressure boilers at Commonwealth Edison Company's Waukegan Station. Accurate records show that this 240 gallon per minute fully automatic plant consistently produces an adequate supply of high-quality feedwater for both medium and high-pressure boilers. Now, five years after it was first put in operation, the plant is still doing the job for which it was designed.

When you specify an INFILCO Demineralization Plant, you can rely on its performance because it is designed by a firm with the widest range of engineering know-how in the water and waste treatment field. For more information see your Consulting Engineer or write.

INFILCO

The one company offering equipment for all types of water and waste treatment, coagulation, precipitation, sedimentation flotation, filtration, ion exchange and biological purification.

INFILCO INC. 918 South Campbell Avenue, Tucson, Arizona
Offices in principal cities in North America 5524

For more data circle 539 on Post Card

Painting, courtesy Power Magazine

New J-M Color Code identifies metal in Spirotallic® Gaskets

Most engineers know that Spirotallic Gaskets maintain a perfect seal despite extreme fluctuation in fluid pressure and flange compression. Consequently, these gaskets are used in a wide range of service conditions which include high temperatures, elevated pressures and active corrosives. To withstand these conditions, Spirotallic Gaskets employ a variety of corrosion-resistant alloys.

Because so many of these metals look alike, only expensive tests or costly experience with the gasket could determine the gasket metal used, once its identifying tag was lost. Now the color patch on the centering guide tells the metal employed and saves time, trouble and expense. This new method of identification also makes it easier for storekeepers and mechanics who handle the gasket. In addition, it simplifies inventories.

Spirotallic Gaskets hold their seal because they are made of spirally wound interlocking plies of asbestos and spring-like metal strip. These gaskets compress easily with light bolting. For catalog PK-35A and copy of color code card write Johns-Manville, Box 60, New York 16, N. Y. In Canada, Port Credit, Ont.

Here are seven of the metals available and their color identifications

Zinc-coated steel—white

Type 304 Stainless—yellow

Type 316 Stainless—green

Type 347 Stainless—blue

Monel—orange

Copper—brown

Aluminum—aluminum

Johns-Manville SPIROTALLIC GASKETS

For more data circle 540 on Post Card

this is "life insurance" for boilers

It's a good "policy" to protect your valuable boilers with YARWAY Boiler Level Indicators.

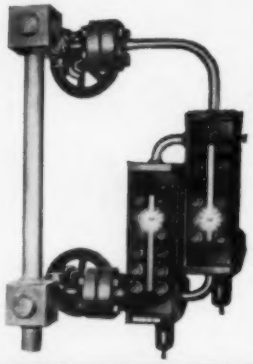
Instant . . . accurate . . . continuous remote readings of boiler water levels are available on the instrument panel or wherever you wish in the plant.

YARWAY's new "wide vision" face gives brilliant readings from any angle . . . and the pointer is always visible, even at extreme high and low water levels.

For brilliant "shines like a star" readings on the boiler drum you'll want to use YARWAY Flat Glass Gages with Type "M" Illuminators.

From drum to panel and at all remote locations, YARWAY equipment gives you the safest boiler protection you can buy—proved beyond doubt in nearly 10,000 installations.

Yarway Remote Liquid Level Indicator. Write for Yarway Bulletin WG-1824.



Yarway Flat Glass Water Gage with Type "M" Illuminators. Write for Yarway Bulletin WG-1812.

YARNALL-WARING COMPANY
100 Mermaid Avenue, Philadelphia 18, Pa.
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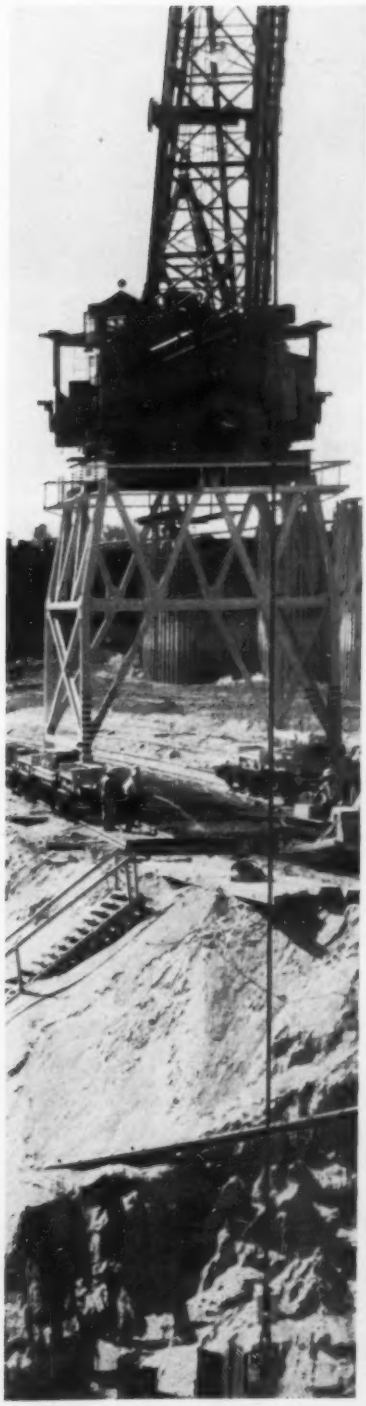
YARWAY **steam plant equipment**

For more data circle 541 on Post Card

Jim Woodruff Dam Builders Try New Ideas With Standard Equipment



It isn't done often, but there is no reason why a walking dragline cannot be mounted on a tower and railroad trucks to become a gantry crane. And why not use a paper mill screen washer to clean concrete? Such originality has speeded construction of Woodruff Dam

By D. L. WHITEHURST

JIM WOODRUFF DAM builders, the Perini Walsh Mills & Blythe Bros. Companies, came up with some unique ideas during the construction of this Chattahoochie River project.

For example, when it became apparent that they would require a gantry crane of certain dimensions for the job, they took a look first at the equipment on hand. They discovered that a walking dragline used on a previous job had the desired boom reach and capacity, so they decided to make their own gantry.

The existing Page, Series 620 walking dragline was first stripped of its legs and feet. A steel tower 35 ft high was designed, fabricated and erected on the job to receive the cab, and the lot was mounted on eight railroad trucks. Two 25-hp electric motors drive two axles through open gear trains to provide motive power.

Since it was necessary for the crane to operate from a level about equal with the top of the coffer dams (see Fig. 1), the preceding modification was deemed both economic and necessary. If fill were used, the necessary 45 degree slope would put the top of the fill too far away from the work area for the 135-ft boom to reach. The tower, of course, gives the necessary altitude without lateral displacement.

The problem of cleaning laitance from large areas of fresh concrete was solved with equipment normally used only in cleaning paper mill screens and rolls. A 2000–2200-psi, 20-gpm positive displacement pump was mounted on wheels to supply a portable "gun" with a steady supply of water. The gun nozzle orifice measures only 0.116 in., but passes the 20-gpm output at the operating pressure. If the pressure tends to build up, a spring-loaded by-pass valve is capable of recirculating any or all of the flow.

While this equipment proved entirely satisfactory, an increase in pressure might increase the effective range of the water jet. This may be tried in the near future with a different pump capable of about 5000 psi, though the jet reaction may prove more than a man can handle without mechanical assistance.

When Jim Woodruff Dam is completed late this year, it will generate 30,000 kw with three 10,000-kw adjustable blade propeller type turbines. The estimated cost of $46,379,000 is high for a power dam, but it is also part of a Chattahoochie River navigational project.

Fig. 1. Originally a walking dragline, this gantry crane was designed, fabricated and erected on site by builders

Fig. 2. Laitance, a scum that forms on the surface of fresh concrete, is difficult and expensive to remove in large quantities. The contractors shortcut their problem by using a 2000-psi water jet to blast it off wholesale, improving finish and bonds

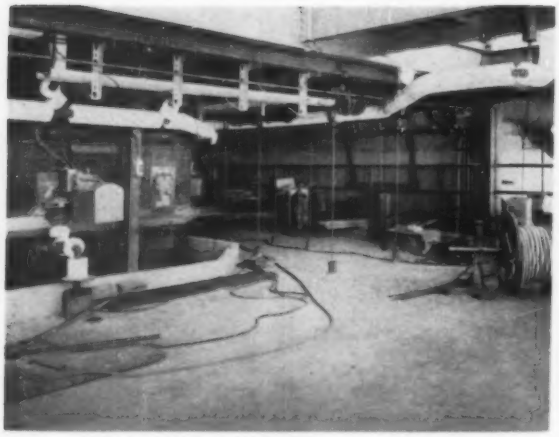


Fig. 1. Pencil rods hold mineral wool block to waterwall. Economizer (right) is finished with a mineral wool cement

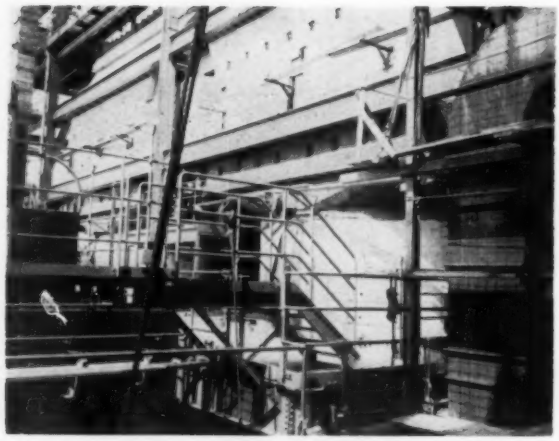


Fig. 2. Wire fabric is welded to duct stiffeners (right) to support insulation. Separators (left) are insulated, coated

Insulation Specs Pay at Cromby Station

Detailed specifications for materials and application methods were used at Philadelphia Electric's Cromby Station. They were designed to obtain low maintenance and high insulation efficiency

By M. C. RANDALL *

Table I. Insulation thicknesses specified for cylindrical and flat hot surfaces

INDOOR			TEMPERATURE RANGE	OUTDOOR		
FINISH	SUB-FINISH	INSULATION		INSULATION	SUB-FINISH	FINISH
⅜" MWC		1½" MWB	PERSONNEL PROTECTION to 600F	1½" MWB	⅜" MWC	MM
MM	⅜" MWC		PERSONNEL PROTECTION above 600F			
⅜" MWC			100F to 200F			
		2" MWB	201F to 300F	2½" MWB		
		½" MWB	301F to 400F	3" MWB		
		3" MWB	401F to 500F	3½" MWB		
			501F to 600F			
			601F to 700F			
		4" MWB	701F to 800F	4½" MWB		
MM	⅜" MWC		801F to 900F			
			901F to 1000F			
		4½" MWB	1001F to 1100F	5" MWB		
		5" MWB	1101F to 1200F	5½" MWB		

MWB = Mineral Wool Block
MWC = Mineral Wool Insulating-Finishing Cement
MM = Mastic Membrane

NOTE: Where insulation is 3 in. thick and over it shall be applied in two layers of equal or nearly equal thickness

EFFICIENT, economical thermal insulation of flat and large cylindrical high temperature surfaces of boiler components in the modern electric generating station depends upon the following factors: the insulating material selected, its thermal efficiency, workability and thickness; and, the methods used for its installation. Each of these fundamental factors was carefully considered in the design and installation of insulation at Cromby Station, Philadelphia Electric Company's large generating station located on the Schuylkill River, near Phoenixville, Pa. Designed to produce 365,000 kw, the station is powered by two boilers, one a 1,050,000-lb-per-hr pressurized fired boiler and the other a 1,450,000-lb-per-hr suction boiler.

Insulating Materials

Felted mineral wool block was selected as the basic insulation for all flat and cylindrical surfaces at Cromby. Light and easy to handle this material is easily cut to fit angles, curves or irregular shapes. Its felted structure yields to surface irregularities allowing it to be pressed tight against the hot surface without cracking or breaking. The block selected for use at Cromby was Mono-Block, felted from spun mineral fibers by the Baldwin-Hill Company.

Thermal requirements for mineral wool block were based on the following surface heat losses to still air at 80 F from vertical flat surfaces when insulated with one inch thick block:

(1) not to exceed 2.80 Btu per minute per square foot where the surface temperature is 500 F, and

* Philadelphia Electric Company

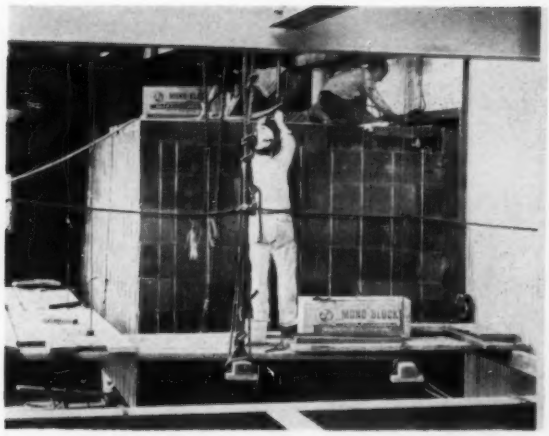


Fig. 3. First layer of block attaches to wire fabric on hot air duct. Second layer attaches to bands over the first

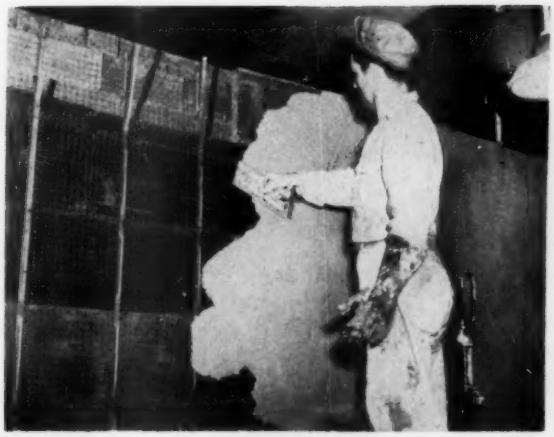


Fig. 4. Mineral wool insulating-finishing cement goes on duct grey, dries to a white. Note two-layer construction

(2) not to exceed 4.85 Btu per minute per square foot where the surface temperature is 700 F.

These correspond to heat conductance rates of 0.40 and 0.45 Btu per sq ft per hr per degree F temperature difference for one inch thickness at the respective hot face temperatures.

Values for thicknesses other than one inch would be in inverse proportion to those given.

It was further specified that the block be water resistant, and show no signs of deterioration or decrease in insulating efficiency after continuous exposure to a temperature of 1400 F for 48 hours; nor after continuous exposure to a temperature of 1000 F for a period of two years.

Mineral wool insulating-finishing cement was selected as a finish material over the block insulation for indoor surfaces at up to 600 F, and as a sub-finish material for indoor surfaces having a surface temperature greater than 600 F and for all outdoor surfaces. The cement was required to be plastic, capable of sealing, pointing and finishing and to develop adhesion of not less than 6 psi on metal surfaces. Specifications also required a cement having less than 1 per cent linear and 3 per cent volumetric shrinkage.

Insulating requirements called for a cement with heat resistance to limit surface heat losses to still air at 80 F, from vertical flat surfaces covered with one-inch-thick cement, to:

(1) 4.55 Btu per minute per sq ft when the hot surface temperature was 500 F, and

(2) 7.11 Btu per minute per sq ft when the hot surface temperature was 700 F.

Heat conductance values corresponding to these hot surface temperatures were 0.665 and 0.69 Btu per sq ft per hr per degree F temperature difference.

The cement was required to be water resistant and show no signs of deterioration, nor loss of insulating capacity after continuous exposure to a temperature of 1600 F for 48 hours, after continuous exposure of 1200 F for a period of two years. Super Powerhouse Cement, also manufactured by Baldwin-Hill Company, was chosen as the plastic finish or sub-finish material for flat and cylindrical surfaces. In addition it was used to insulate valves and fittings and irregular surfaces.

This white mineral wool insulating-finishing cement presents a bright white surface when dry after a finish troweling. It provides a smooth durable finish suitable for painting without requiring a sizing compound for either water or oil paint.

An asphalt cutback mastic composed of mineral fillers specially plasticized for spray application was chosen as a finish for all outdoor surfaces and for indoor surfaces hotter than 600 F. Inert to all types of chemical reagents and capable of withstanding continuous operating temperature cycling from − 40 to 600 F without cracking, running, losing adhesion or losing plasticity, it has a moisture vapor transmission rate of less than 0.05 grams, per 100 sq-in., per 24 hours. An impregnated, 38 mesh glass fabric was used in conjunction with the mastic. Woven of long glass fibers, the material has been pre-treated with an asphalt compound during manufacture to promote rapid impregnation by the mastic.

Insulation Thickness

Insulation thicknesses specified at Cromby Station are shown in Table I. Based on an exterior surface temperature of 120–140 F the table details the insulation of surfaces ranging in temperature from 150 to 1200 F.

Temperature ranges are shown in the center column of the table and combinations of insulations for indoor and outdoor installations are read to the left and right respectively. For instance, reading from the table it can be seen that a surface whose temperature is between 601 F and 700 F would be insulated with 3 in. of mineral wool block and $\frac{3}{8}$ in. of mineral wool insulating-finishing cement with a mastic membrane finish if located indoors, while $3\frac{1}{2}$ in. mineral wool block, $\frac{3}{4}$ in. mineral wool cement and a mastic membrane finish would be applied to the same surface outdoors.

Installation

Wherever possible, the specifications for installing insulation at Cromby Station were simplified and standardized in order to reduce the number of different materials stocked and to speed construction. However, the methods also provide secure, positive attachment. These methods are detailed, step-by-step, in Table II.

Lagging studs, tie wires and steel pencil rod straps were used to attach the mineral wool block to boiler and boiler accessory casings. Holes drilled in casing stiffeners also accommodated tie wires. Wherever the exterior casing temperature was greater than 701 F two layers of block were applied, using staggered joint construction. Figures 1 and 2 show insulation applied in this manner.

Mineral wool block insulation was attached to breeching and duct work on a steel fabric base using special notched clips and steel bands. The clips secure the steel bands to the fabric base at block joints as shown in Figures 3 and 4.

The direct fastening method, in which the steel fabric is welded directly to the plate, was used on top horizontal surfaces in order to support the weight of operating and maintenance personnel who may walk on these surfaces. Flanges and stiffeners protruding from the duct surfaces were covered with half-sections of molded pipe insulation.

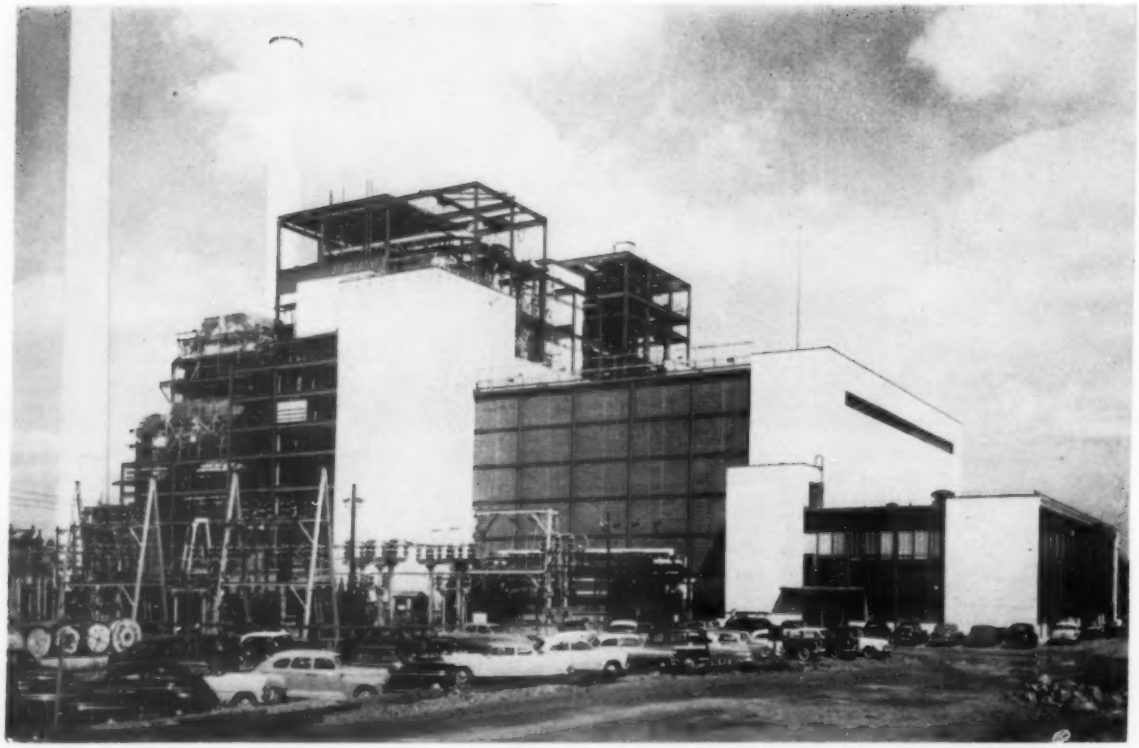


Fig. 5. View of Cromby Station. Large amount of outdoor work called for thermal shock and water resistance plus strength

The direct fastening method was also used on cylindrical surfaces for convenience of application.

However, spaced construction, in which the mesh is secured to the preformed stiffeners located every 30 in. along the duct plate (Fig. 2), was used on the sides and bottom horizontal (overhead) surfaces of all ducts and breechings. This method is the simpler of the two because the mesh need not be cut to fit between stiffeners, and no special methods or extra materials are necessary to insulate the stiffeners which are covered by the basic course of mineral wool block. In addition, it presents a smooth unbroken exterior surface.

As shown in Table II a $\frac{3}{8}$-in. coat of white mineral wool insulating-finishing cement was used as either a sub-finish or finish. (*See opposite page.*)

When required by the specifications in Table I, a layer of asphaltic mastic, an application of mastic membrane and a second layer of mastic completed the job (Figures 2 and 6).

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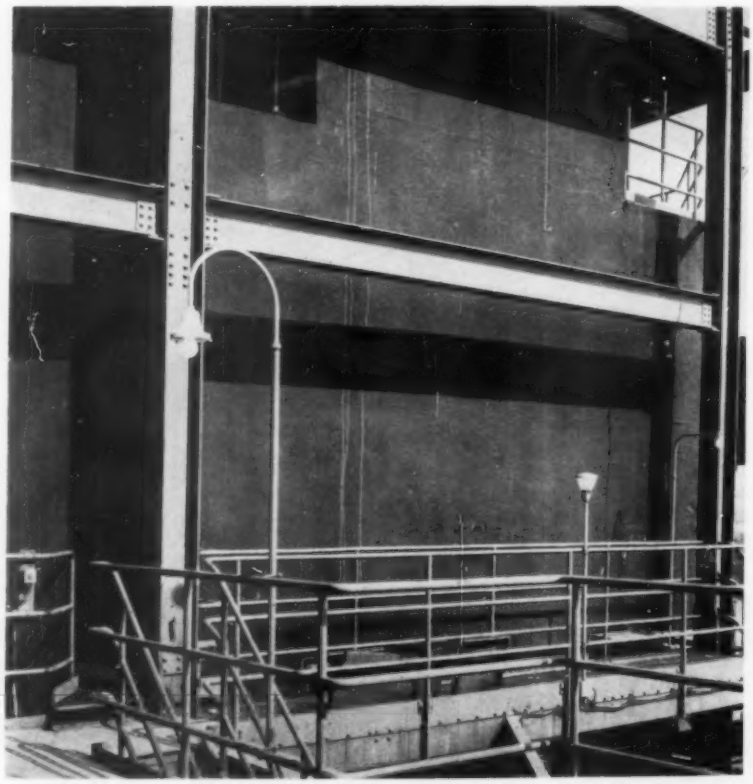


Fig. 6. Finished outdoor insulation on the economizer of boiler No. 1. Weatherproofing and installation withstood Hurricane Hazel shortly after its completion

Table II. Methods of applying insulation to flat and large cylindrical surfaces, Cromby Station of Philadelphia Electric Co.

EQUIPMENT TO BE INSULATED	BREECHING AND DUCTS		BOILER CASING AND BOILER ACCESSORIES
	TOP HORIZONTAL AND CYLINDRICAL SURFACES	VERTICAL AND OVERHEAD SURFACES	
APPLICATION MATERIALS	1. 6 x 6-in. mesh, #8 gage steel fabric (road mesh) 2. ¾ x .02-in. steel bands, corrugated on 12-in. centers 3. Splice pieces for steel bands 4. Galvanized notched clips 5. Plasterer's corner bead* 6. #14 gage steel tie wires* 7. Molded pipe insulation*		1. 2 x ¼-in. lagging studs 2. #14 gage annealed steel tie wires 3. ¼-in. diameter steel pencil rods 4. Plasterer's corner bead
FOUNDATION	1. Weld wire fabric to surface on 24-in. centers so that:	1. Weld wire fabric to stiffeners so that:	1. Weld lagging studs to casing on 12-in. centers
	2. Exterior wires of mesh are vertical on vertical surfaces and parallel to long axis of duct on horizontal surfaces		2. Loop tie wire through studs
INSULATION	1. Attach blocks to mesh using bands and clips on 12-in. centers 2. Attach second layer of block if required, stagger block joints. Secure clips to bands holding first layer 3. Cover flanges, stiffeners, etc., with half-section molded pipe insulation wired to outer steel bands.*		1. Press first layer of block against casing and pull wires through 2. If required, apply second layer of block, stagger joints between layers, pull wires through 3. Secure wires to pencil rods applied horizontally over outer layer of block on 12-in. centers
SUB-FINISH AND FINISH (as required)	1. Secure corner bead to all corners on flat surfaces 2. Apply ⅜-in. layer white mineral wool insulating-finishing cement. a. Finish with wooden trowel if mastic is to be applied b. Finish trowel to smooth surface with metal trowel if cement is final finish 3. After sub-finish is clean and completely dry, apply bedding coat of mastic with spray gun at rate of 5 gal per 100 sq-ft. Wherever possible equipment should be at maximum operating temperature 4. When bedding coat is tacky, but before it has set: a. Roll or brush membrane fabric into mastic so that no voids or blisters exist b. Overlap membrane sections a minimum of 2-in. Cement laps with mastic c. Roll until membrane is thoroughly impregnated. 5. Apply final mastic coat 24 hr after membrane has been set into bedding coat. Spray at rate of 5 gal per 100 sq-ft		

* Not required on cylindrical surfaces

Return Lines Failing? Identify the Cause Before Prescribing Treatment

Return line corrosion is like a bellyache: You must know the reason for the trouble before you can correct the cause. Oxygen and carbon dioxide corrosion are relatively easy to differentiate and gage, so proper dosage and treatment are fairly easy to prescribe

By JOSEPH R. COURSAULT*

CORROSION in the condensate return lines of boiler systems is a frequent problem. To properly prescribe a solution to the difficulty, it is necessary to determine the primary cause of the attack. Prompt elimination of serious return line corrosion is certainly most advisable since necessary maintenance and replacement of pipe and fittings can be quite costly.

By far the most common causes for return line corrosion are the presence of either dissolved oxygen or carbon dioxide, or both of these gases. The appearance of the corroded sections will be a good indication of the cause. An attack by carbon dioxide will be characterized by an actual thinning of the metal wall of the pipe, with associated grooving of the metal. Such attack is illustrated in Fig. 1 and Fig. 2.

On the other hand, corrosion by dissolved oxygen will be evident from a series of pits, and ordinarily deposits of the reddish colored iron oxides. Such attack may be observed in Fig. 3. It is not uncommon to see the results of attack which is due to both oxygen and carbon dioxide. As may be expected, the appearance of such attacked sections will have the combined characteristics of the oxygen and the carbon dioxide corrosion, previously discussed.

Aside from the actual appearance of the pipe after attack, it is often possible to anticipate whether corrosion in the return system will be a problem, and if so what the responsible factor will be. Ordinarily, a few simple tests will permit predicting whether oxygen or carbon dioxide will be a problem.

Oxygen

Oxygen attack is due to the fact that boiler makeup, especially if the makeup is a surface supply, will contain appreciable quantities of dissolved oxygen.

The corrosion reaction for dissolved oxygen may be illustrated as follows:

(1) $4Fe + 6H_2O + 3O_2 \rightarrow 4Fe(OH)_3$
Iron + Water + Oxygen → Ferric Hydroxide

The ferric hydroxide formed can revert to iron oxide (rust) as follows:

(2) $2Fe(OH)_3 \rightarrow Fe_2O_3 + 3H_2O$
Ferric Hydroxide → Iron Oxide + Water

Since dissolved oxygen's solubility decreases with increasing temperature, it is obvious that when the feedwater for the boiler undergoes elevated temperatures in the boiler itself, the dissolved oxygen, unless deaerated external to the boiler, will be liberated, imposing the danger of oxygen corrosion and pitting. This fact makes the use of an open or deaerating heater of utmost importance in good engineering design of a boiler plant. With such an installation, properly operated, by far the major portion of the oxygen in the water will be removed before that water enters the boiler.

The use of an open or deaerating heater, of course, accomplishes what is referred to as the mechanical deaeration of the boiler feedwater. Since mechanical deaeration is not successful in removing 100 per cent of the dissolved oxygen present, the feed of a chemical deaerant is economically justified to assure that the last traces of the dissolved oxygen are removed. Ordinarily sodium sulfite (Na_2SO_3) is used for this purpose. The reaction of the sulfite with the oxygen proceeds in accordance with the following:

$Na_2SO_3 + \frac{1}{2}O_2 \rightarrow Na_2SO_4$
Sodium Sulfite + Oxygen → Sodium Sulfate

Recently, however, hydrazine (N_2H_4) has been applied to achieve the same result, oxygen removal. Since hydrazine is considerably more expensive, its use has been confined to high pressure installations where the concentration of dissolved solids is critical. Unlike sodium sulfite, hydrazine does not increase the solids of the boiler water.

In addition to the means previously mentioned for establishing the cause of return line corrosion, namely by noting the appearance of the attacked sections, and by review of mechanical and chemical deaerating practices, there also exists the possibility of conducting a dissolved oxygen test on the boiler feedwater. This test, while requiring careful technique, and actual determination immediately after the sample is procured, does give very reliable results. Oxygen corrosion and pitting can be a serious problem when an oxygen concentration of 0.1 ppm is present in the feedwater. The use of sodium sulfite is desirable to assure the removal of the oxygen from the feedwater. Oxygen attack can take place, however, not only due to inefficient deaeration of the feedwater, but also through the possi-

* W. H. and L. D. Betz, Philadelphia, Pa.

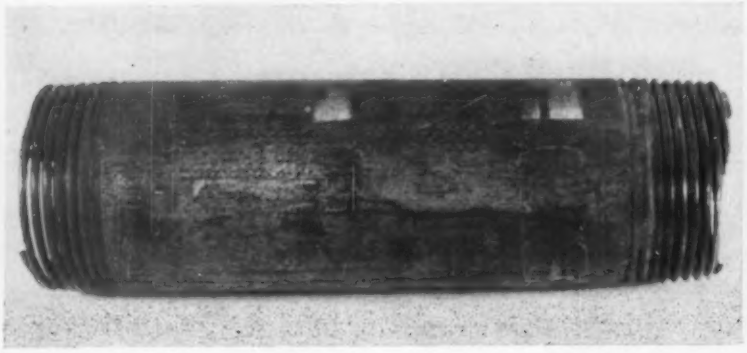


Fig. 1. This condensate return pipe failed due to carbon dioxide attack. Such failures usually occur at threads (as shown) because of thinner sections at roots

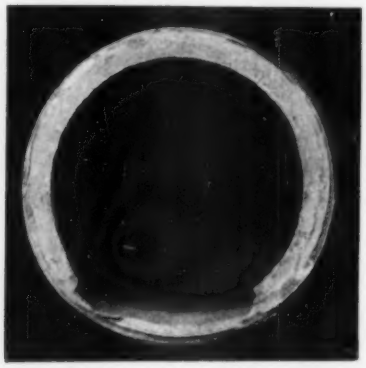


Fig. 2. Grooving attack by CO_2 is shown in this end view of the condensate pipe

bility of oxygen leaks into the condensate by having air drawn into the condensate at pumps, or other points in the system where air may come in contact with the condensate. This potential difficulty could be checked by conducting dissolved oxygen tests on the condensate itself, in addition to the dissolved oxygen tests on the feedwater. If it is determined that oxygen is not present in the feedwater, and is not present in the condensate, oxygen will not be the cause of the attack of the return condensate system.

Carbon Dioxide

The next consideration will be the cause of attack by carbon dioxide. An open or deaerating heater will remove any free carbon dioxide from the feedwater, but such removal will not eliminate the presence of carbon dioxide in the steam. Since bicarbonates and carbonates present in boiler feedwater will undergo decomposition at elevated temperatures to form carbon dioxide, the result of this decomposition is the chief source of carbon dioxide in the steam. The reactions proceed as follows:

(1) $2NaHCO_3 + \text{heat} \rightarrow Na_2CO_3 + CO_2 + H_2O$

(2) $Na_2CO_3 + H_2O + \text{heat} \rightarrow 2NaOH + CO_2$

While reaction (1) will proceed to 100 per cent completion, the decomposition indicated in reaction (2) proceeds to only about 80 per cent completion. With these reactions as a basis, it may be calculated that for each 1 ppm of bicarbonate alkalinity in the feedwater, expressed as calcium carbonate, 0.79 ppm of carbon dioxide will be evolved. For each 1 ppm of carbonate alkalinity in the feedwater, 0.35 ppm of carbon dioxide will be evolved. All other things being equal, the higher the carbon dioxide content of the steam, the greater will be the corrosion potential. The severity of the anticipated attack may be roughly anticipated by conducting the methyl orange alkalinity determination on the boiler feedwater. In some cases a carbon dioxide concentration as low as 6 ppm may cause a troublesome corrosion problem in the return piping.

However, in addition to the carbon dioxide concentration of the steam, there is one other important consideration in anticipating the severity of corrosion due to carbon dioxide, and that consideration is with respect to the quantity of carbon dioxide involved, as well as the concentration of the carbon dioxide. Figure 4 clearly illustrates this point. It may be noted that with a carbon dioxide concentration of 6 ppm or above, the rate of corrosion increases rapidly as the rate of flow increases. Furthermore, another factor which can materially influence the severity of carbon dioxide attack is the possibility for stratification of the carbon dioxide, leading to an abnormally high rate of attack for the particular flow rate of the condensate, and expected concentration of carbon dioxide.

Since the carbon dioxide contamination results from an actual breakdown of the carbonate and bicarbonate alkalinity of the feedwater, deaerating practices will be ineffective in reducing the corrosion potential due to this gas. Effective reduction of the corrosion potential may be achieved by external treatment of the feedwater or makeup water to reduce the bicarbonate alkalinity thereof. Such external treating facilities would include lime-soda, and lime-gypsum softening, which ordinarily reduce the alkalinity to the 50–60 ppm range. It is advisable, from the standpoint of reducing carbon dioxide corrosion to maintain the softener effluent alkalinity in the carbonate-hydrate form, rather than in the form of bicarbonate-carbonate. Other external methods of reducing bicarbonate alkalinity include acid feed, hydrogen zeolite softening, and dealkalization.

When external softening cannot produce a sufficiently low alkalinity of the feedwater, or carbon dioxide concentration of the steam, to reduce the corrosion rate in the return lines to an acceptable level, or when the expense for such external treating facilities is not justified when all factors are considered, excellent protection from attack can be achieved with the use of neutralizing amines or filming amines. A number of factors must be considered on an individual basis for each plant to determine the most advisable course of action to follow to most economically correct the corrosion problem in the return lines of the boiler system.

Conclusions

1. Oxygen and carbon dioxide are the chief causes of return line corrosion.
2. Attack by dissolved oxygen is characterized by pits and build-up of deposits of iron oxides.
3. Attack by carbon dioxide is characterized by grooving and actual thinning of the metal pipe walls.
4. Combined attack by oxygen and carbon dioxide will have the characteristics of each.
5. Failure, particularly due to carbon dioxide, is likely to occur first at threaded sections because the metal is thinner at such points than in the normal pipe wall.
6. Oxygen attack can be stifled by efficient chemical and mechanical deaeration.
7. Carbon dioxide attack can be inhibited by external reduction of alkalinity and/or use of filming or neutralizing amines.

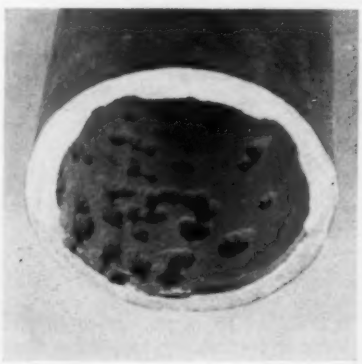


Fig. 3. Oxygen attack seems to bore holes, is distinctly different from CO_2

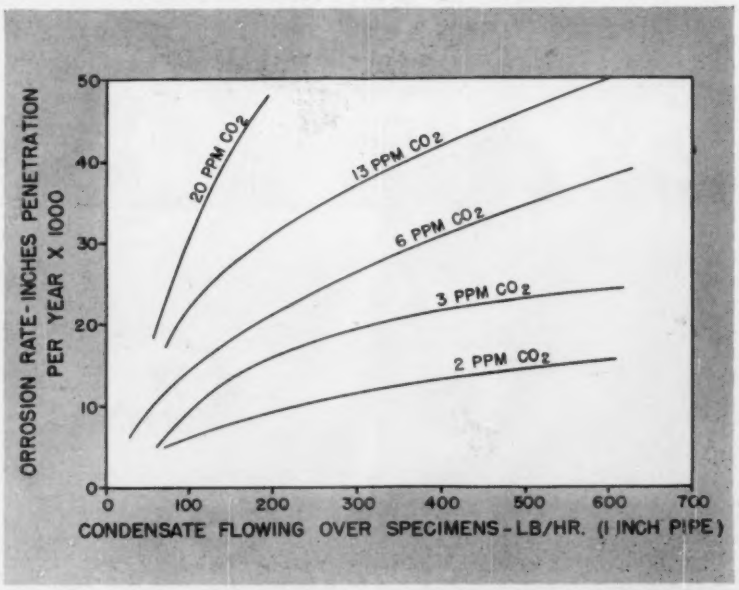
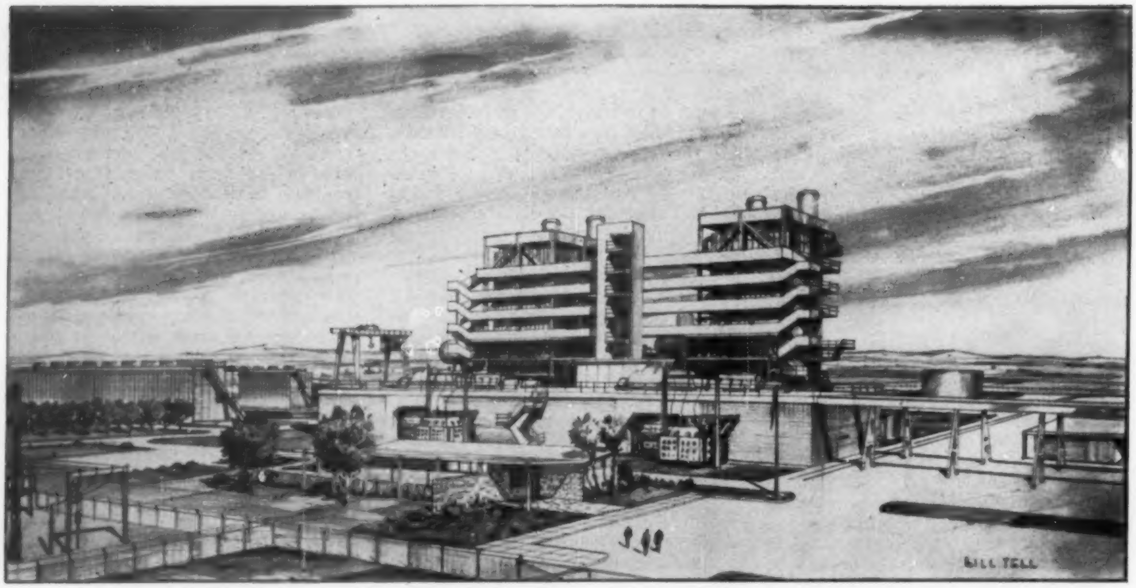


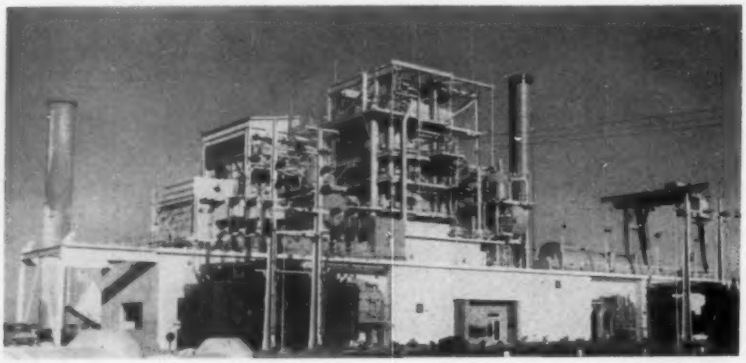
Fig. 4. Corrosion rate of CO_2 depends on its concentration and flow rate. Note the drastic rate increase with flow increase at concentrations above 6 ppm CO_2

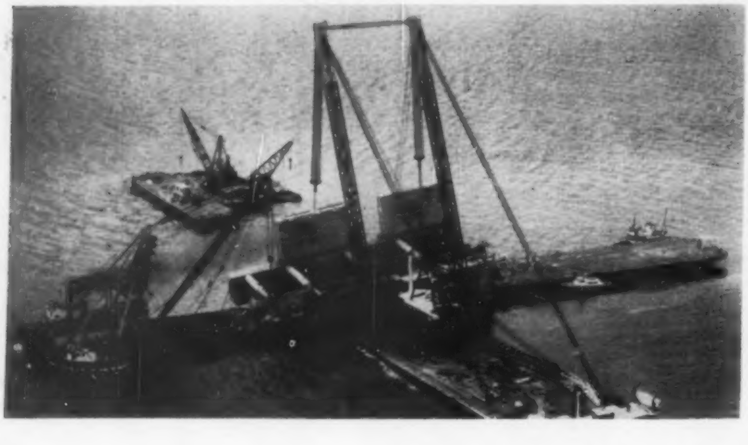


News Reel

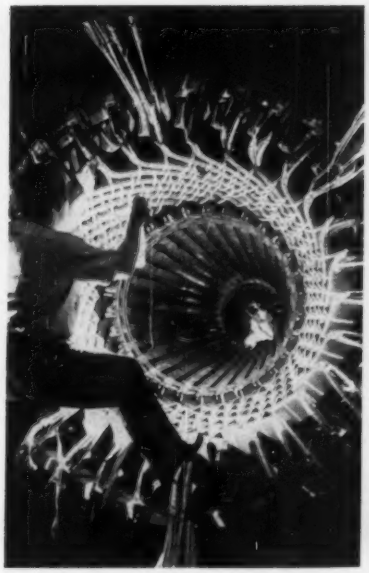
Power Engineering • Power Engineering • Power Engineering • Power Engineering

Even before the first 100,000-kw unit of the new Agua Fria Steam Plant started building, a second identical unit was voted and approved. The plant (shown above) is similar to the Kyrene Steam Plant at Tempe, Arizona (below left), which serves the same system — Salt River Power District. Both utilize semi-outdoor construction, but the Agua Fria Plant will have administrative offices in front of the plant in a separate building. The two tandem compound turbine generators run at 3600 rpm with steam at 1800 psia, 1000 F and 1000 F reheat. Cooling water for the Kyrene Plant comes from the Western Canal while the Agua Fria Plant gets its water from wells and uses a 10-cell cooling tower. Natural gas will fuel the new plant, but 40,000 barrels of oil will be held for emergency fuel. Combustion and water glasses will be observed through 17-in. TV screens on the console in these modern installations when in operation

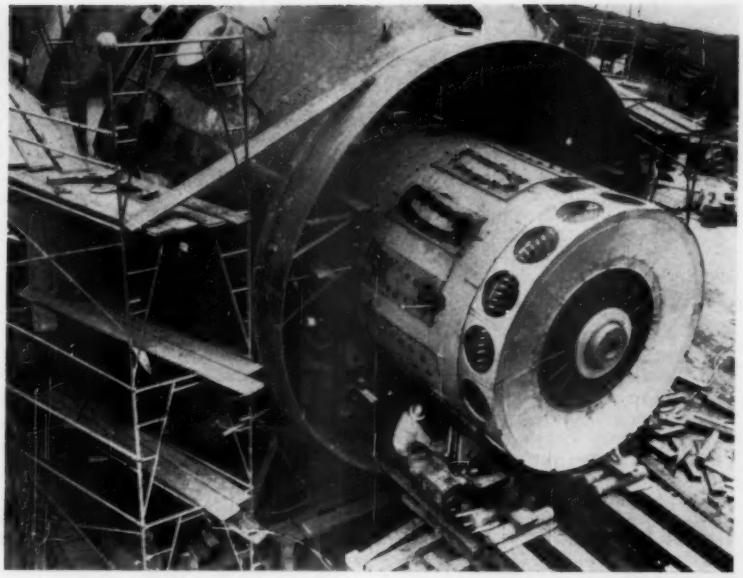




Future off-shore oil drilling platforms may be built with the aid of this huge new derrick which is capable of lifting 800 tons in a single lift. Made by the American Hoist and Derrick Co., it is designed to lift prefabricated deck sections onto the pilings after these sections have been floated out from shore. Previous record for a block-and-fall single lift was 400–500 tons

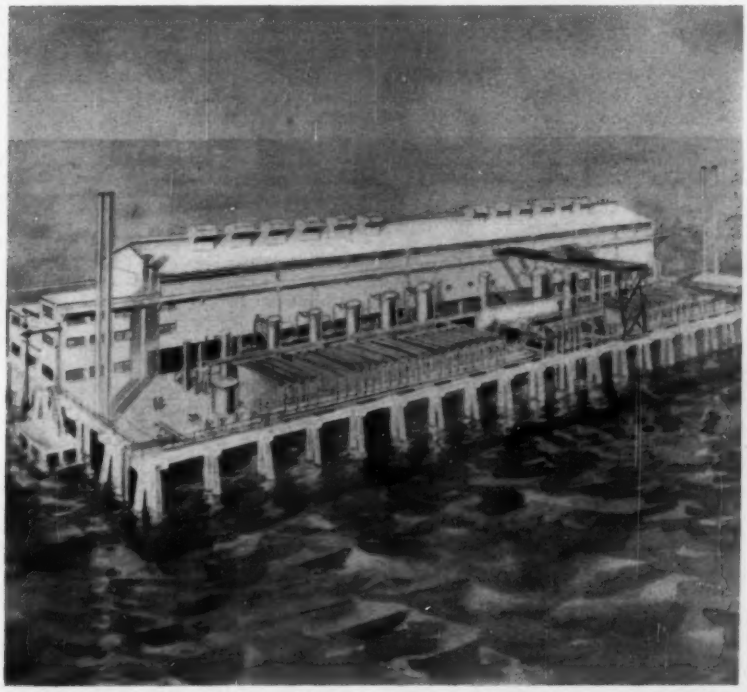


These windings will generate 250 mw at 24 kv—both records in this country—when installed at TVA's Gallatin Station. Westinghouse is building the huge unit



How to stretch a wind tunnel: Two new 20,000-hp Westinghouse electric motors will boost air to mach 1.8 while original motor acts as starter (So. Cal.)

(Right) New York's Institutional Power Plant Engineers had a meeting recently in New York City, and some of their members found time to visit the Worthington Permanent Exhibit at 99 Park Ave. Here (l to r) co-chairmen H. E. Sullivan and J. M. Savage check exhibit with Pres. D. L. Alloway and Editor Andrew Kramer



Twelve 8000-hp gas turbines (96,000 hp total) will be installed on this platform seven miles from shore in Lake Maracaibo, Venezuela, to return 300,000,000 cu ft of natural gas per day to the earth. Objects are to conserve gas, repressurize oil wells, and recover large quantities of oil from the gas. (Westinghouse units)

Los Angeles foundation factory! Trenchers such as this Cleveland unit have cut the footings for 60,000 houses in the area for Bowles & Son in last 5 years

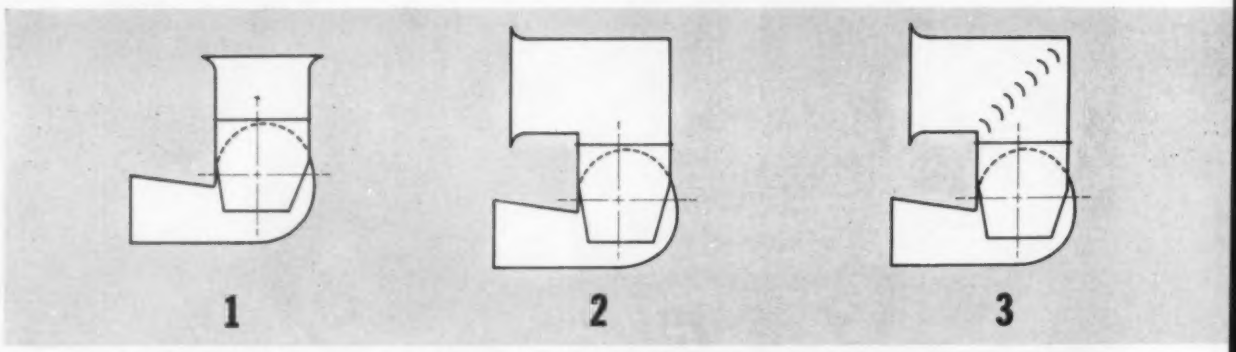


Fig. 1. Centrifugal fan with straight inlet. Point A on curve in Fig. 4 obtained with inlet duct of this type

Fig. 2. Fan with square 90 deg bend at inlet. Point B on curve in Fig. 4 was obtained with inlet duct of this type

Fig. 3. Square 90 deg bend with guide vanes. Point C on curve in Fig. 4 was obtained with inlet duct of this type

Bad Ductwork Can Spoil Fan Performance

Forced and induced draft fans are often blamed for poor boiler performance when the real offender is the ductwork. A few duct changes as explained here can give large increase in steam output

By W. E. WENDOVER *

IN THE LAYOUT and design of ductwork for steam generators, the portions near the forced and induced draft fans should be carefully designed to get maximum effectiveness from the fans. Experience has shown that the capacity, efficiency, and length of life under erosive conditions may be markedly influenced by the shape and direction of the ductwork adjacent to the fans.

Fan performances are usually calculated from the results of previous laboratory tests of full size or geometrically similar fans. The tests are made with a standard arrangement of the fan, and the arrangement and method of test were perfected over a period of many years by the National Association of Fan Manufacturers. (1) It is not common practice to test all fans when manufacture is completed, since by use of the well-known "fan laws," calculation of the performance of a fan is a remarkably accurate and practical procedure.

While the value of the N.A.F.M. standard test methods has been well proven, they represent idealized setups and arrangements which are seldom, if ever, realized in mechanical draft practice. While it is common practice to specify fans for 15 to 20 per cent greater capacity, and 30 to 50 per cent greater pressure than the values obtained by analysis of boiler requirements, experience has shown that in some cases a poor duct arrangement has reduced fan capacity and pressure to a much greater extent, resulting in unsatisfactory installations which could not produce their full design rating. It therefore behooves the power engineer, before buying and installing fan equipment to develop and follow some general policies for checking fan and duct arrangement, to ensure practical and satisfactory results.

It is proposed here to review the findings of some general investigations, to cite a number of recent fan installations where operation has been impaired by poor duct arrangement and to set forth a set of general rules, covering fan and duct arrangement to act as a guide for both the designer and the power engineer.

Two papers (2) (3) on the influence of bends and obstructions in ducting present the results of laboratory tests of a forward-curve, radial-tip, 24-blade centrifugal fan of a conven-

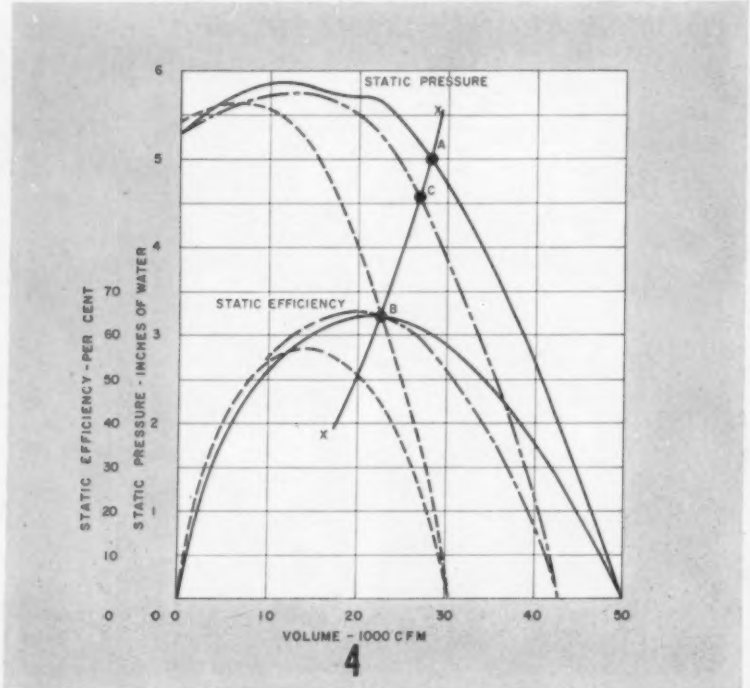
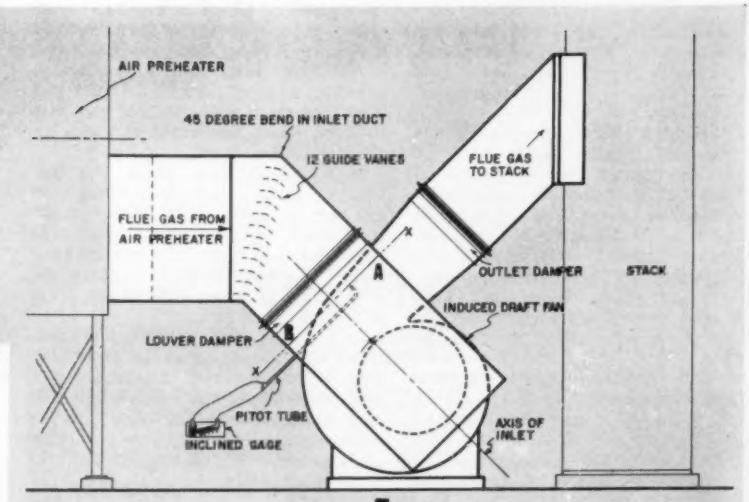


Fig. 4. Tests showing effect of bends in inlet ducts with and without guide vanes

* Power Plant Equipment Department, American Blower Corporation



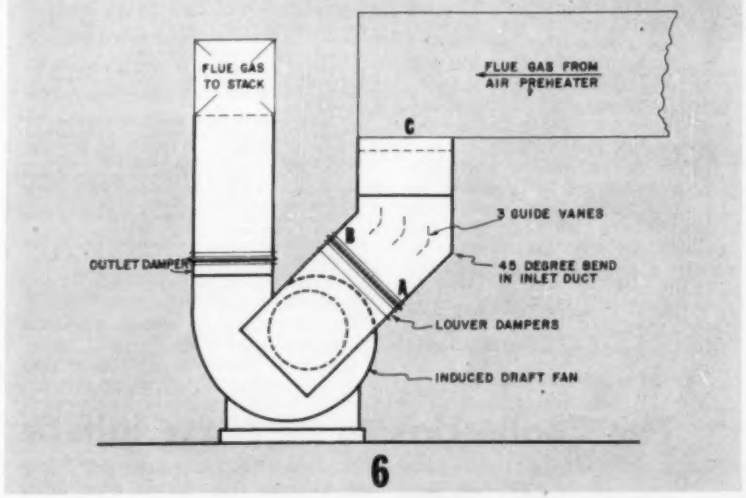


Fig. 5. Pitot tube traverse across "xx" showed high velocities at A, low velocities at B. After 12 guide vanes were installed, velocities were uniformly distributed

Fig. 6. At start-up, velocities were high at A, low at B. Result—lowered draft. After 3 guide vanes were installed in duct, design capacity of boiler was exceeded

tional design often used in mechanical draft installations. Tests were made with a number of different arrangements of inlet and outlet ducts, and it was found that poor distribution of air caused by bends at the inlet reduced fan capacity by as much as 40 per cent, and the efficiency over 25 per cent, in some cases.

The effect of bends at the fan outlet were not so marked, but the fan used in these tests had a very good outlet velocity distribution, which is not always the case. The beneficial effect of guide vanes in bends close to the fan was also proved by these tests.

Figure 4 shows the results of one of the tests, made with a straight inlet, and then with a square bend at the fan inlet, with and without guide vanes in the bend. Let us assume that the fan had been selected to handle 28,000 CFM at 5 in. static pressure (Point A), and required 36.7 horsepower at an efficiency of 60 per cent. The curve of system static pressure versus volume is shown as line x-x. When installed with a square 90 deg bend at the entrance to the inlet boxes, the fan actually would handle only 22,500 CFM on this system (Point B), or about 80 per cent of the expected capacity.

The power required would be only 26 hp, but this would represent a very poor static efficiency of 45 per cent. If guide vanes were installed in the bend, as described in the original paper, about 27,000 CFM (Point C) or 97 per cent of the expected capacity would be obtained, with an efficiency of almost 60 per cent. This points out the benefits which might be obtained by adding guide vanes in the field to help right an installation in trouble from this source.

Two recent cases of this sort might be reviewed here to further illustrate.

Case A: Each of three 125,000 lb. stm/hr. boilers was served by a double inlet induced draft fan having a 39 in. diam wheel, and arranged as shown in Fig. 5. When first starting up the units, it was found that maximum steam generation was limited by the amount of induced draft available, to 88,000 lb per hr, or about 70 per cent of designed capacity. A velocity traverse by pitot tube across the entrance to the inlet boxes of the induced draft fan showed a very uneven distribution, with the highest velocities occurring on the upper side of the entrance to the inlet boxes.

Four guide vanes were installed in the bends ahead of the fan inlet, and the boiler capacity was then increased to 95,000 lb per hr. Adding five more guide vanes, or a total of nine, increased boiler capacity to 120,000 lb per hr. Pitot tube traverses after each addition of vanes showed a definite improvement in velocity distribution at the entrance to the inlet boxes of the induced draft fan. Calculation showed that the optimum number of guide vanes was twelve, so the nine vanes were removed and twelve equally-spaced vanes were installed in the bend.

By this time, a 42 in. diameter wheel for one induced draft fan had been made available, so this was also installed. After these changes, the boiler capacity was found to be 130,000 lb per hr, well above the designed rating.

Case B: Involved here were six large induced draft fans, serving three steam generators, each designed for 630,000 lb per hr. The fans were arranged as shown in Fig. 6, with two induced draft fans handling flue gas from each boiler and discharging to a common stack. Initial operation of the units showed a maximum rating of 585,000 lb per hr, limited by the capability of the induced draft fans.

A crude uncalibrated pitot tube was made up on the job, and a velocity traverse at the face of the induced draft fan inlet boxes showed a velocity of about 7000 ft per min at the bottom, but zero velocity at the top of the inlet box. Three guide vanes were made up and installed in each bend, and after slight modification to produce the best velocity distribution, it was found that 660,000 lb per hr could then be obtained easily from each unit. Improvement in the flow conditions also might have been obtained by installing guide vanes in the bend from horizontal to vertical flow at point C, but it was not done at this time.

In every installation the designer should strive to obtain a good uniform velocity distribution in the duct

work near the fans, in order to permit the fans to operate under the same conditions as they would have in an N.A.F.M. test set-up. This is becoming more important all the time, as increases are made in the size of units and in fan efficiencies. Obviously, it would be ridiculous to build a unit which would only produce 70 per cent of its design capacity and operate with fan efficiencies of 80 per cent of the expected values, and yet this happens all too often.

The effect of ductwork design on fan erosion is not quite so easy to pin down. Reference (4) in the bibliography describes an actual installation where the life of an induced draft fan, operating under erosive conditions, was increased to more than three times the original life, by modifying the ductwork to produce a more symmetrical flow to the fan.

Symmetry is the main factor involved in obtaining a long induced draft fan life under erosive conditions. If the duct work leading from the boiler outlet to the induced draft fan is designed to produce equal gas flows and equal dust loadings into each inlet of a double inlet fan, maximum fan wheel life will be obtained, since the erosive action of the dust is expended over a greater area, and thus does not wear through the fan blades or wheel parts as rapidly. Naturally, symmetry of flow is also important for obtaining the desired fan capacity and efficiency.

The following rules are intended for use as a general guide in laying out duct work:

1. When the first preliminary layouts of boiler, ducts and fans are made, provide for good duct arrangement relative to the fans, for if this is not done, it will usually be impossible to do it later.

2. Avoid bends in ducts adjacent to the fans. Where bends must be used, provide an "aspect ratio" of at least 6 to 1, or provide guide vanes to produce the same result. Use bends of less than 90 deg wherever possible.

3. Use gradual contractions and enlargements in the ducts in connecting to the fans. Remember that velocities are usually higher near the fans than at any other point in the system.

4. The included angle between sides (or top and bottom) of the "pair of pants" connecting the duct to the inlet boxes of a double inlet induced draft fan should not be more than 30 deg, and preferably should be 15 deg.

5. Provide space for an evase or gradually expanding outlet duct at the fan discharge in the original layout, and advise the fan vendor how much space is available. He will then be able to make use of the efficient regain of pressure in the evase to select the fan best suited to the requirements of the system.

6. Make the entire ductwork system as symmetrical as possible, to avoid unbalanced flows and dust loadings. Where two fans are used in parallel for one boiler, provide symmetry about the centerline of the boiler unit.

7. When it is suspected that flow from boiler, air-preheater, or dust collector outlet may not be uniformly distributed over duct cross-section, investigate fully, and if necessary, provide a good length of straight duct between such points and the induced draft fan inlets to even up the velocity pattern.

8. Avoid layouts where the discharge flow from fans impinges against surfaces perpendicular to direction of flow, or where discharge from two fans is directly toward each other. Extremely high turbulence, vibration and noise may result from such arrangements.

9. Consult with the fan manufacturer when doubt arises in connection with arrangement of fans and ducts. His experience will usually permit him to determine the effect of unusual duct connections, or to decide on the most practical arrangement for a given situation.

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The Coolie Has to Be Materialistic

THE ATOMIC Manhattan Project of World War II brought a new concept which will shortly sweep through all engineering in all industry, R. S. Stevenson, president of Allis-Chalmers Manufacturing Co., told the Society of Automotive Engineers recently.

Addressing the golden anniversary tractor meeting of the SAE at the Schroeder Hotel, Stevenson pointed out that in that project, "for the first time in the history of the world, on such a massive scale, we went into mass production before the prototype had ever been built. Our scientists and engineers were sure, two billion dollars were appropriated, and they proved they were right.

"This gives the engineers and scientists behind them a whole new area in which to work. It means that we can apply sound calculations and expert laboratory techniques to shortcut some of our old methods, which we called testing but which were nothing but trial and error.

"This concept is now being applied to almost every phase of atomic energy development — full scale atomic energy power plants are now being designed and will be built without a prototype or pilot plant ever having been in operation. The concept is also being used in the electronics and advanced metallurgical field. It is my conviction that it will shortly sweep through all engineering in all industry.

"After giving full credit to the climate of economic and political freedom which makes it all possible, engineering operating within that climate is most responsible for the dynamic economy which we have in America today.

"While our economy is dynamic," Stevenson said, "we do not accept that such an economy is necessarily materialistic. The coolie or the peasant who is chained to the soil merely to grub out his daily living can only be materialistic; but our people, who have the comforts and the leisure and the wherewithal, have every opportunity to develop their cultural and esthetic tastes.

"Engineers," Stevenson pointed out, "calculated the average human being developed only one-tenth of a horsepower. America is now using over six and a half billion mechanical horsepower, enough to provide over 100 horsepower for every wage earner. That's how we get things done, and that's why our economy is dynamic."

New Filter for Ordinary Air

Cloth filters have high cleaning efficiencies for industrial dust but are less effective for cleaning air. Now special coating inside the cloth bag is designed to give 99 per cent efficiencies for cleaning ordinary air

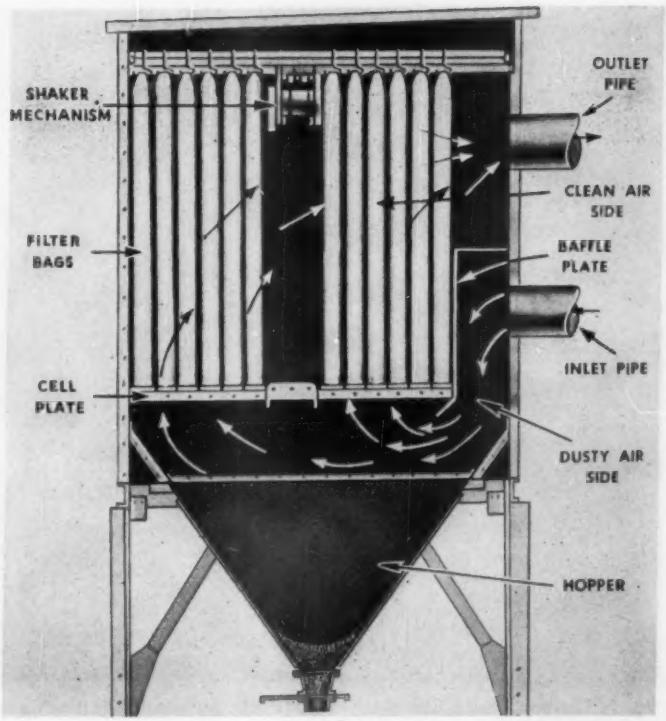


Fig. 1. Section through cloth bag filter showing air flow. Filter aid is applied to inside of bags and greatly increases cleaning efficiency

PRINCIPLE OF this ultra-filtration method consists of passing air to be cleaned through cloth filter tubes (bags) coated on the inside with special filter aid which provides a matrix on which fine particles of atmospheric dust and tarry matter are collected. One application of the filter aid will last from two to three years under normal conditions.

Figure 1 shows a typical collector using ultra-filtration, from which it will be seen that the equipment is little different from standard, with the air to be cleaned passing through the filter tubes (bags) which are coated on the inside with filter aid. The equipment is very little more expensive than regular cloth filtration equipment. The filter aid is inexpensive and only minor modifications to the hopper are needed on standard equipment.

Cleaning is Easy

After two or three years of 24 hr a day operation, the resistance to air flow across the cloth tubes and filter aid becomes sufficiently great (as indicated by a manometer on the collector) to require more power for moving the air through. When this point is reached the filter tubes need cleaning.

The bags are mechanically shaken by a built-in device which causes the collected dust and the filter aid to fall down into the hopper for disposal. Fresh new filter aid is then applied and the filtration process is resumed. This is the only attention required, as the filter tubes themselves last indefinitely. Thus maintenance costs are very low.

Long Shaking Interval

In the Chicago area, for instance, an industrialized section of the country with quite dusty atmospheric air, data shows that the shaking interval is about three years, with the back pressure, or pressure drop, through the collector not exceeding 2½ in. water gage during that time.

It should be made clear that this ultra-filtration equipment is not a replacement for ordinary cloth filtration for controlling the usual industrial dust problems. For ordinary dust control for say, grinding or brushing operations, chemical batching, conveying, dumping, bagging, sawing, coal crushing, etc., ordinary cloth filtration has efficiencies of 99 per cent and better against these kinds of dust.

But where you are cleaning ordinary atmospheric air for the sort of applications listed below, ordinary cloth filtration would give efficiencies of only 30 to 60 per cent, so ultra-filtration is employed. It gives better than 99 per cent collection efficiencies.

Conversely, ultra-filtration would be pointless for the usual industrial dust problems, because there would be no advantage. It would mean paying for filter aid without having a need for it.

Here are some of the applications for which ultra-filtration is designed to be singularly effective:

1. Ventilation, pressurizing, and cooling of electrical control rooms, transformer rooms, and other enclosures in which heat generating electrical equipment is located.
2. Direct cooling by pressurizing housings or enclosures of electric motors, electrical switch gear and controls, bus bars, telephone circuits, air cooled transformers, etc.
3. Filtering fresh air to compressor and blower intakes to reduce wear on this equipment.
4. Removal or recovery of minute quantities of hazardous radioactive materials.
5. In association with air conditioning or ventilating systems, to remove virtually all small particles from recirculated or makeup air.
6. Pressurizing working spaces located in dusty areas.
7. Supplying air to diffuser plates and tubes in activated sludge sewage plants.

If you want more information about this filtration method write ULTRA-FILTRATION on one of the prepaid post cards elsewhere in this issue and mail it to us at 110 S. Dearborn St., Chicago 3, Ill.

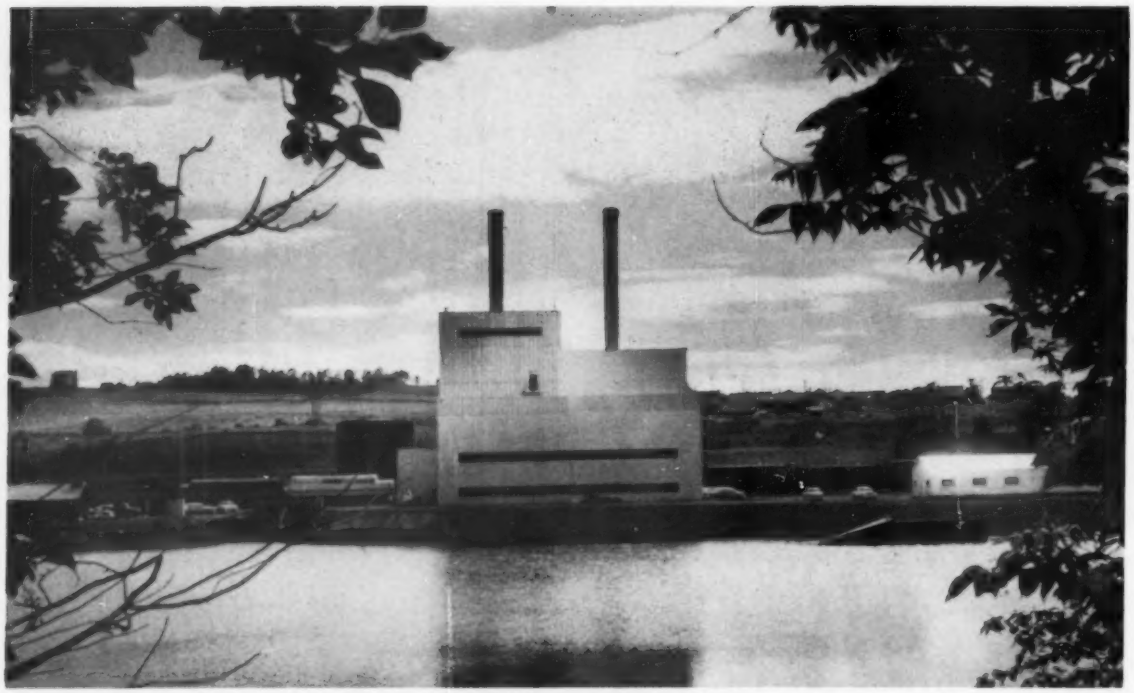


Fig. 1. Caribou Power Center of Maine Public Service Co. at Caribou, Maine where two-unit 20,150-kw steam-electric plant, an 8100-kw diesel plant and an 800-kw hydro plant are adjacent on bank of Aroostook River, held open house

Your Customers Deserve a Good

Here is the way they held it at the Caribou Power Center, with excellent results. People who pay your electric utility company bills for the "juice" that runs their refrigerators, ranges, water heaters, flat-irons, toasters, coffee makers, electric fans and lights, are the ones who give you your real public relations. They'll boost you to the skies if you'll invite them into your power houses to see how you make the electricity that comes on at the flick of a switch

By CHESTER R. EARLE*

POWER PLANT open houses aren't new, by any means. The power industry used to have many more of them before the war than it has had since. During the war, many utilities could not do it and it has taken a little time to revive the custom. Such open houses are one of the fundamental sources of really effective public relations.

Now most power plant open houses follow a general pattern, but the one held last summer at the Caribou Power Center in Caribou, Maine, while it did follow the general pattern, had some features that were particularly interesting. This story of how they did it may form a useful review and check-up for those who have held open houses; and for those who haven't, it may breed some ideas.

Primary reason for the Caribou open house was the formal placing in service of the second steam electric generating unit in the Caribou Steam Plant that was described in the May 1954 issue of POWER ENGINEERING in the article Caribou Integrates Steam, Diesel and Hydro. At Caribou, the Maine Public Service Co., with headquarters in Presque Isle, Maine, has established a power center on the bank of the Aroostook River. There a single 7500-kw steam turbine generating unit was installed in 1950 in a new steam plant right alongside an 8100-kw diesel plant and an 800-kw hydroelectric plant. During 1954 and early 1955, a new 12,650-kw steam electric generating unit No. 2 had been installed in the steam plant, Fig. 2. That second unit has some unusual features, such as a pressurized furnace boiler and other details described in some detail in the above article. The second steam-electric unit, like the first, was designed by close coöperation between the engineers of Maine Public Service Co. and their consulting engineers, Stone & Webster Engineering Corp. with E. H. Barry as project engineer.

The Maine Public Service Company's system serves an area of about 3600 square miles in the Northeastern part of Maine; the area has a population of about 125,000 people in 67 communities. The total capability of the system is 44,400-kw of steam, diesel and hydro power, including three other hydro plants. Of this, the Caribou Power Center shown here supplies 30,600-kw, and the system contains over 1200 miles of power lines. The backbone of the transmission is designed for 69-kv, but is operated at present at 33-kv.

Accordingly, the Maine Public Service Co. decided to hold an open house when the new steam unit No. 2 was placed in service, and in doing so it decided that the open house would be first of all for the benefit of the customers in its area and not for "brass hats." (A "brass hat" open house was held later in the year).

Now to run a good open house of this kind you first have to make up your mind that you are going to do it, and there is always a certain amount of questioning as to whether you ought to do it or not, especially if you haven't done it before — and the MPS people hadn't. In the words

*Executive Editor, POWER ENGINEERING

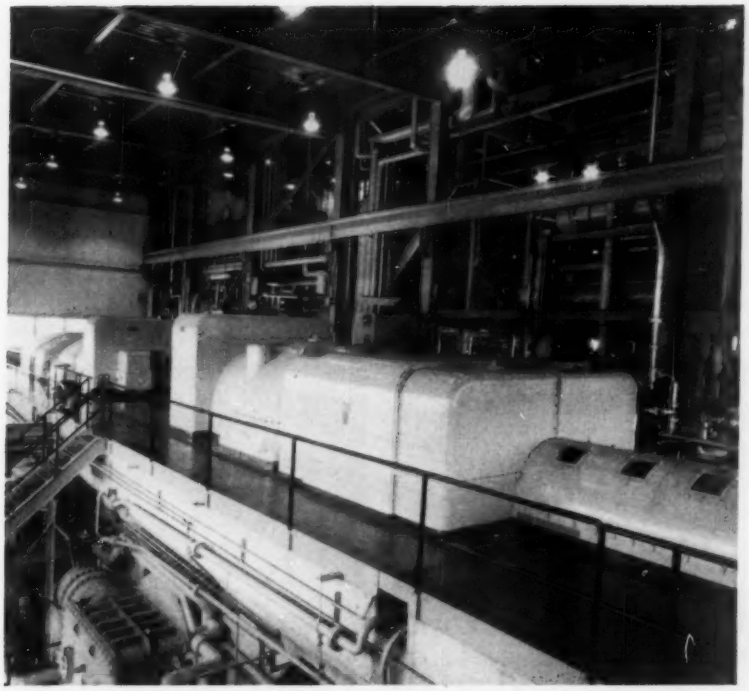


Fig. 2. In foreground, new Unit No. 2, a 12,650-kw steam turbine generator installed in 1955; 7500-kw Unit No. 1 in background. Photo courtesy Elliott Co., Inc.

Fig. 3. Group of visitors on the operating floor at the Caribou open house

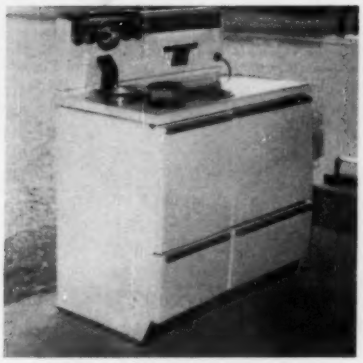


Fig. 4. Grand prize drawn for at open house was splendid electric range

Power Plant Open House

of the song, "You got to have heart" and you've got to have some luck, but once you make up your mind to do it you've got to go ahead full speed. So, under the very capable leadership of MPS President L. H. Alline, an Open House Committee was formed with Vice President M. S. Blackwell as chairman, and L. J. Bero, R. A. Barton (advertising and publicity manager), P. H. Brown, V. P. Currier, K. R. Durst, M. S. Mosher and J. A. Roche. They set a date, began the detailed planning and began advertising the open house.

The date finally set was July 29, 30 and 31, falling on Friday, Saturday and Sunday, so that even if farmers or other customers couldn't get away the first two days, they could on the third. The committee began to get editorial publicity in the local newspapers of the area, also used paid advertisements. Some of the exhibits in Fig. 5 show examples of how they did this.

Especially noteworthy was the publicity obtained through the company's own house organ *The Hot Line*, edited by R. A. Barton, Sr. Many of the pictures shown here were taken by Mr. Barton, others by the writer, with their own cameras.

Another good stunt was to send out postal card invitations to every one of the MPS customers. The MPS people knew it was good psychology to have the visitors, and especially the women folks and children, look forward to receiving a prize if they were lucky. So in this case, the Committee provided door prizes of electric flat-irons for each hundredth visitor, and a grand prize of a splendid electric range, to be drawn at the end of the open house.

They also provided for light refreshments and soft drinks, and a supply of souvenirs for every guest. These souvenirs, as shown in Fig. 5, consisted of Reddy Kilowatt tie clasps, a supply of magnetic pot holders that

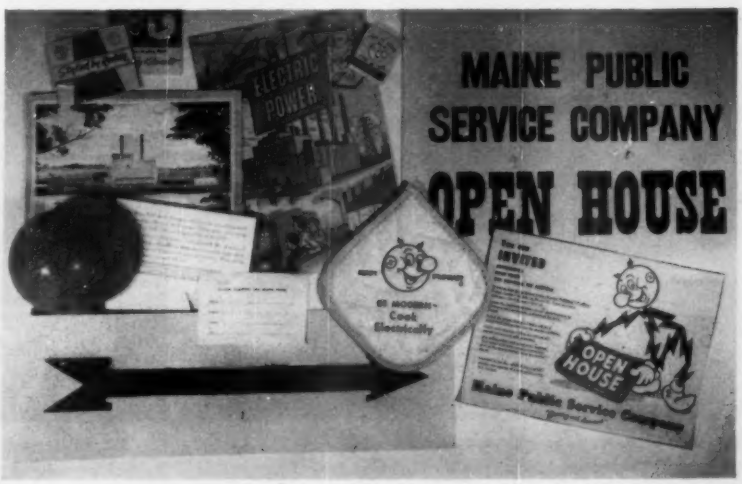


Fig. 5. At Caribou open house, Reddy Kilowatt tie clasps, magnetic potholders, balloons for children, cartoon books were souvenirs. Newspaper ads, personal post card invitations, booklet on Power Center, road signs, gave publicity

Fig. 6. Parking space near plant for visitors' cars at Caribou open house

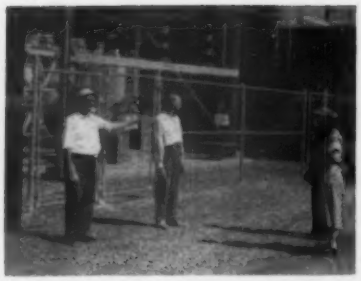


Fig. 7. Guides show Caribou open house visitors where to start plant tour

Fig. 8. Visitors passed through to register in marquee between plants

Fig. 9. Door prizes of electric flat-irons given to each 100th person registered

Fig. 10. Group of men and women visitors registering at the registration desk

Fig. 11. Marquee provided shade, rest benches, and soft drinks for everybody

you can stick right on the side of your stove, and balloons for the children.

This problem of inviting families with children is a serious one. You have to be sure that they are accompanied by adults and kept away from any part of the equipment where they could touch something or push a button and get themselves or the station into trouble.

At the Caribou open house, this was taken care of by making sure that no children were admitted unless an adult registered with them and accompanied them. Also, for the smaller tots, a section of the marquee (the entertainment pavilion) was set aside for them. Two capable women were put in charge of it, provided with coloring books, games and toys, and kept the toddlers well entertained.

The Open House committee not only made provisions to have everything cleaned up and in proper operating order, but to have everything labeled with proper signs on each unit of equipment. They laid out a course for the visitors to follow in going through the plant and arranged to rope it off. You can't put the ropes on the equipment, so they provided wooden or metal stands to hold these.

They assigned some of the personnel as guides for groups of visitors and trained them in what they were going to tell the visitors about the various units and the general operation of the plant.

They made sure that on the day of the open house, everything was properly cleaned up around the yard and the plants. They arranged to post big yellow signs with black lettering all over town and with arrows pointing to the plant. Traffic guides were identified by brilliant yellow safety helmets and plant guides and personnel by white caps.

As a registration and hospitality center for the visitors, a large marquee (tent) was erected between the new steam plant and the adjacent diesel plant. They made sure that the tent was a good sturdy one and properly erected with side curtains to come down in case of a sudden shower. Under it they planned to put the counter for serving coffee and soft drinks, provided a space there to take care of the small children, and supplied benches and seats for resting the feet and getting away from the sun.

You want to register your visitors,

Fig. 12. Visitors showed keen interest in motor vehicle equipment and line material on truck, explained by four guides

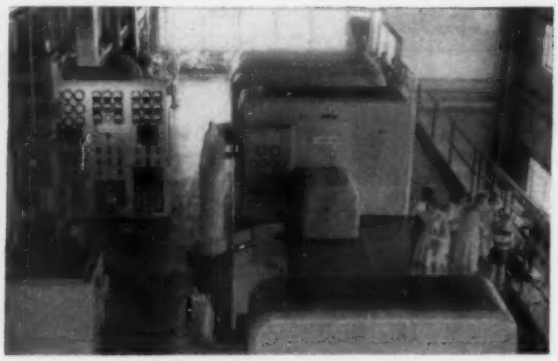


Fig. 13. New turbine-generator unit No. 2, 12,650-kw, with control panels at left, with group of visitors to open house

Fig. 14. M. S. Blackwell, MPS vice president and C.R. Earle, PoE executive editor

Fig. 15. Guide showing visitors through the Caribou 8100-kw diesel plant

Fig. 16. Open house guide explaining use of some of power plant control panels

Fig. 17. Two very able women kept toddlers occupied with games and crayons

Fig. 18. Another view of a guide showing party through plant at open house

Fig. 19. In large and small parties, guests formed almost continuous parade

not only to get a check on who they are but, if you offer prizes, as they did at Caribou, you have to register them and give them numbered prize cards in any case. Also when they register, you give them one of the souvenirs that you have provided, balloons for the kiddies and things of that kind.

It was clear they should have some kind of a souvenir booklet to give everybody who registered, telling about the Company and what it does in that particular area. This was done at Caribou by the use of a very attractive little booklet entitled Welcome to the Caribou Power Center with a picture of the Center on the front cover. Inside was a greeting, a list of the Company's directors, officers and managers, a brief description of the outstanding features of the system, and a diagram, starting with a tea kettle and a fan, showing how electricity is made and delivered. Following this were some technical statistics about the Power Center and the general power supply for Aroostook County.

Another good souvenir was a comic book entitled Electric Power, prepared and copyrighted by Westinghouse, and showing in cartoon style how we learned to develop electric power, with very simple explanations of what a power plant is and how the power gets distributed around to homes and factories, and how it gets used in all those places.

The committee had to think of how the people were going to get to the Power Center; in an area like that of Caribou, it would be primarily in their own cars or coming along with friends in their cars. So they provided parking space for individual passenger cars, with proper signs and directions for getting into it. Of course, they assigned personnel to act as traffic directors.

And so the great day arrived at Caribou. A perfect day, with the temperature about 80 in the sun, but with a pleasant cooling breeze blowing down the river, and a clear sky. On that day, just as the open house was scheduled to begin, a great airplane from a nearby Air Base came sailing majestically over the area and dipped low in a salute to Maine Public Service Co. Promptly at 2:30 in the afternoon of July 29, the first of the visitors began to drive into the parking space, shown in Fig. 6.

They were directed to the proper entrance by a guide as shown in

Fig. 20. On steam plant operating floor, new 125,000-lb-per-hr, 600-psi pressurized furnace steam generator on left

Fig. 21. Babes in the Hardware! Where did that guide go? Little brother inspecting. No danger; equipment not operating

Fig. 7. They registered on a numbered registration card in the tent shown in Fig. 8, looked at the flat-iron door prize that was to be given to each one hundredth registrant, were served a soft drink, went over and inspected the grand prize that was to be drawn for, Fig. 4, and then the plant guides conducted them to the various parts of the plant, as shown in the other illustrations.

Attendance Over 8000

And they kept on coming that afternoon, men and women and children. In the first part of the afternoon, both the steam turbine generators were in operation, but the load dropped off and No. 1 turbine generator was shut down, leaving No. 2, the newest unit, in operation carrying about 7500 kw.

By the end of the afternoon, so many people had registered and picked up their souvenirs that the Reddy Kilowatt clasps were beginning to run a little short, and it was decided that if this happened on the first day they would need some more souvenirs. They found they could get more Reddy Kilowatt clasps in time, but they could also get some magnetic pot holders, so both were ordered and flown in the next day. Those pot holders made a tremendous hit with the women.

The open house was scheduled to run each evening until 8:30, and by that time on the first day over 1,000 people had registered. On the second day, the attendance was much larger and by Sunday night, when the open house ended, the total registration was over 5,000 people, and the total attendance, including children not eligible to register, was well over 8,000. Some 50 flat-irons had been given out as door prizes, and at the end, when the drawing was held for the electric range, it was won by a local housewife. As a result of the watchfulness of the plant staff and the precautions taken, also the cooperation of parents and the older children, there was not a single "incident."

What They Learned

The visitors all seemed very much interested, even though many of them admitted that they didn't understand many of the details. But they all said that they did get a general idea of what was going on, and of the way in which the plant produced the power they bought.

More important than understanding technical matters, however, was the fact that they got better acquainted with all the utility people and the men who worked in and around the station. The families of the operating personnel got a chance to see "Where Daddy works". The general sentiment among the visitors was that this was an important place and that they were glad to know something about it and that the operations of the utility company would, in the future, be much better understood by everybody concerned.

One important point noted by scores of the visitors was that here was the new unit all in operation, beautifully painted in green, the operating floor painted a fine tomato red and everything spic and span, yet they could see that the boiler and the turbine were generating a lot of power. This gave a chance to explain that the plant was not just cleaned up for the open house, but that it looked that way all the time (except when maintenance work was being done). This, as all power engineers know, is true in all modern power plants and particularly in the utility industry, and it makes quite an impression on visitors, some of whom can remember the old-time coal shoveling days.

Design Gave Visibility

The entire Maine Public Service Company organization was proud to be able to show off its new Power Center, and particularly its new steam-electric generating unit. But the engineers pointed out that without the coöperation of every man on the entire MPS staff it couldn't have gone so well. This writer can confirm that from his own observation while attending this open house.

One feature of this Caribou open house was that the entire operation was concentrated in a small enough space so that it was not too much of an overwhelming spectacle for the non-engineering citizen. For example, standing in the center of the steam plant operating floor, you could see the two steam turbine generators on one side and the two boilers supplying steam to them on the other side.

Many of the heaters are also on that floor with their associated piping, while the control panels for both boiler and turbine are centralized there. So even a non-engineer could see the whole compact plant without much trouble.

To sum everything up, this was a very successful open house in an unusual power center in an unusual area of the country. While the general procedure was not unusual, many of the details were, and the result was the sort of real public relations every utility is striving for; namely, a feeling of admiration and liking for what the local power company is doing.

Rickover Describes *Nautilus* Work at SBME Meeting in Mayflower Hotel

Photo courtesy, Chase Ltd., Washington, D.C.

Rear Admiral Rickover, Gen. Reimel, SBME President Morris

REAR ADMIRAL H. G. Rickover, prominent in the activities of the Atomic Energy Commission and the U. S. Navy nuclear propulsion program, and probably best known by the general public for his work in developing the submarine *Nautilus*, spoke recently to the Society of Business Magazine Editors in Washington, D. C. He is shown at left speaking to General S. E. Reimel, (center) secretary of the Engineers Joint Council and the American Committee of the World Power Conference, and Dick Morris, right, Editorial Director of POWER ENGINEERING Magazine and president of the Society of Business Magazine Editors.

How Much Reactance Do You Need for Safe Short Circuit?

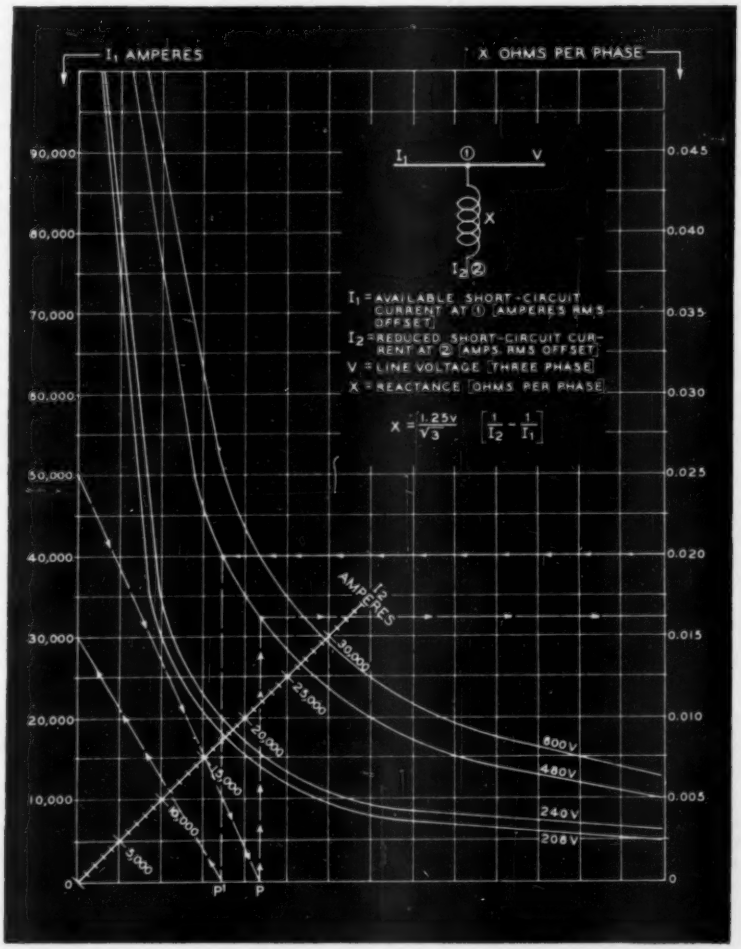


Chart is based on the assumption that resistance of circuit is negligible and that max three phase short circuit current includes factor of 1.25 for d-c component

CHART is used to determine (1) Reactance in ohms per phase required in a 3-phase circuit to reduce the available short-circuit current to some definite value, or conversely, (2) reduction in short-circuit current effected by the insertion of additional reactance.

The following examples show use of chart.

Example 1. To find additional reactance per phase (X) required to reduce short-circuit current from (I_1) to a smaller value (I_2).

Given. Available offset short-circuit current at a 480v bus is 50,000 amp. This current must be reduced to a value that can be safely handled by a circuit breaker having an interrupting capacity of 15,000 amp.

Find. What is the reactance in ohms per phase required of a current-limiting reactor to be installed between the bus and the breaker?

Solution. Join 50,000 on the left-hand scale (vertical) with 15,000 on diagonal scale by a straight line and determine P on horizontal base line. Draw vertical line from P straight up to intersection of 480v curve; read 0.0164 ohm (right-hand vertical scale), the required reactance per phase.

Example 2. To determine effect of additional reactance in reducing short-circuit current.

Given. An air circuit breaker serves a panelboard through a length of cable having a reactance of 0.02 ohm per phase. System voltage is 480, 3 phase. Short-circuit current available at the circuit breaker terminals is 30,000 amp offset.

Find. What is the short-circuit current available at the panelboard?

Solution. Draw horizontal line through 0.02 on right-hand vertical scale. At the intersection with 480v curve draw vertical line downward and determine point P^1 on horizontal base line. Join P^1 with 30,000 on vertical left-hand scale by means of a straight line. On diagonal scale read 11,000 amp, the available offset short-circuit current at the panelboard.

Submitted By R. R. TAGGS

How to Write a Final Construction

Here are details of the system developed by Kaiser Engineers to obtain, for all their construction projects, standardized final reports that are easy to prepare and give all the necessary information

WHEN A BUSY executive is hunting for facts about a completed project, when an engineer is interested in key information for reference, and when an operating superintendent is looking for pertinent data, there is nothing more satisfying than to find all these facts in one volume. Basically that is the function of the final reports prepared by Kaiser Engineers for their clients.

At the completion of each of its construction projects, whether large or small, Kaiser Engineers prepares and issues a comprehensive book of facts covering the work done. This is the final report, a one volume history of each phase of the project as it was accomplished. Over the years it has become an increasingly valuable record. For the executive, either of Kaiser Engineers or plant owners, it provides a uniform set of key information to which ready reference can be made. For the engineer it contains pertinent data on the engineering and construction aspects to assist him in evaluating similar future jobs or in working with any expansion project at the same plant. For the operating engineer who works with the completed facility it has all the design criteria, the physical details of his plant and a wealth of background information.

The reports are normally issued within one month after completion of the project. Several standard sources of information are used which are channeled through a progress and scheduling engineer who not only keeps abreast of the project as it develops, but also prepares the final report. One source is the daily progress report which is issued by the construction superintendent on the jobsite. This field daily is in effect a comprehensive diary in narrative form. It mentions the start or completion of each phase or part of the project. It describes how construction is accomplished if there is any deviation from the universally accepted methods. It also mentions weather conditions, job difficulties, and a host of other details pertaining to the day's work. These daily progress reports are keyed to the construction drawings which enables the progress engineer to follow accurately the progress of construction.

Another source of the field information are progress photographs. These photographs are taken at weekly intervals and always contain one set of standard views from predetermined locations. These standard views are augmented by additional photos whenever necessary if they will aid in telling the picture story of the progress of construction.

The source for engineering data such as the status of drawings is the engineering department. Information concerning procurement and expediting of construction materials comes from the purchasing department. Administrative information relating to contracts, employees, accounting and project cost in comparison with the budget is obtained from standard reports issued by the department concerned.

In addition to these published sources, close liaison is maintained by the progress engineer with the key personnel of the project. Personal visits, telephone calls, letters and interviews with people newly returned from the jobsite are all used to keep the progress engineer thoroughly familiar with the project.

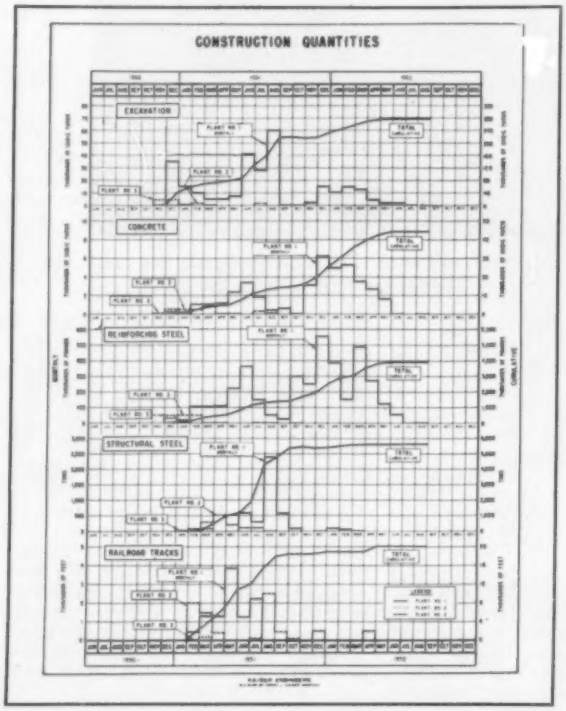


Fig. 1. Chart showing month-by-month and cumulative quantities of main construction materials used on the project

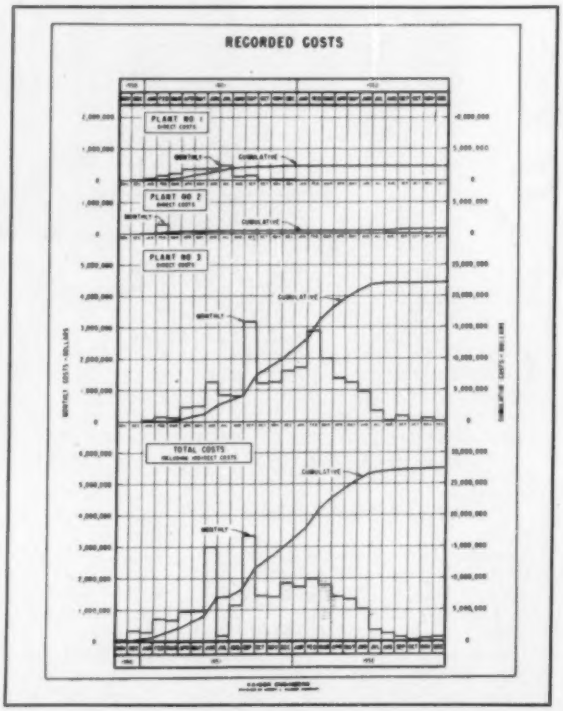


Fig. 2. Direct and indirect construction costs are recorded month by month and also added to give cumulative totals

Report

Each month during the life of the project all of this information is sifted, condensed and edited into a monthly progress report. When the project is completed these monthly progress reports form the basis of the final report. Key information is selected, rewritten and rechecked for accuracy. Photographs, charts and drawings are chosen which along with the introduction and general description will make up the final report.

When completed, the final report is bound in a suitably titled 8½ x 11 leatherette binder. The contents follow a standardized pattern developed after considerable trial and error. This standardization lends efficiency to the preparation of the report and provides easy familiarity with the contents for the reader.

Beginning with an introduction, each report carries in order a list of key personnel, general description of facilities, notes on engineering, the procurement and expediting story, notes on construction, progress charts, photographs and the key general arrangement drawings. In each of the descriptive sections extreme care is taken to make certain that each statement of fact is correct. One error will cause the reader to lose faith in the accuracy of the entire report.

THE AUTHOR
BRUNO FRANCESCHI

About the Author — Graduated from the University of California in 1933 as an Electrical Engineer with a power option. Joined Kaiser Engineers in 1942 working in the schedules and records department on the construction of the Fontana steel mill. In the same year he became head of the department, a position he has held continuously. In addition to the final reports described in this article, he is responsible for company records and photograph files, the engineering library, translations, and project proposal brochures.

Introduction: — Immediately following the table of contents, the introduction serves as a summary of the entire project. All phases are discussed briefly to provide the reader in one or two pages with a general idea of what the project is all about. This section is arranged in chronological order from the authorization to proceed to the acceptance of the project and final costs.

Although the introduction is brief, it is generally the most difficult one to prepare and edit. A considerable amount of time is required in screening out the unessential portions, to bring to the reader's attention only the highlights of the project. Every word in this section must carry its weight in telling the story or it is relegated to the longer descriptions forming the main body of the report.

Key Personnel: — A one-page list of the key personnel who are responsible for the execution of the project follows the introduction. Names and titles are shown as well as the individual's location whether on the jobsite or at Kaiser Engineers' principal office in Oakland.

General Description of Facilities: — This is generally the longest section of the report. Facilities are described fully but without tedious details. Whenever standard equipment or standard construction is used the description is necessarily brief. However, if any portion of the work is intricate or unusual, then it is described in greater detail to make

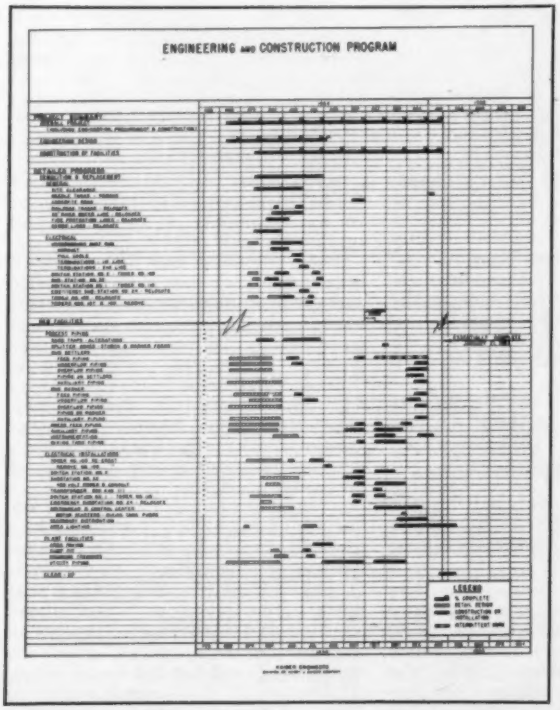


Fig. 3. Bar chart provides progress report during construction and also shows start and finish dates of main jobs

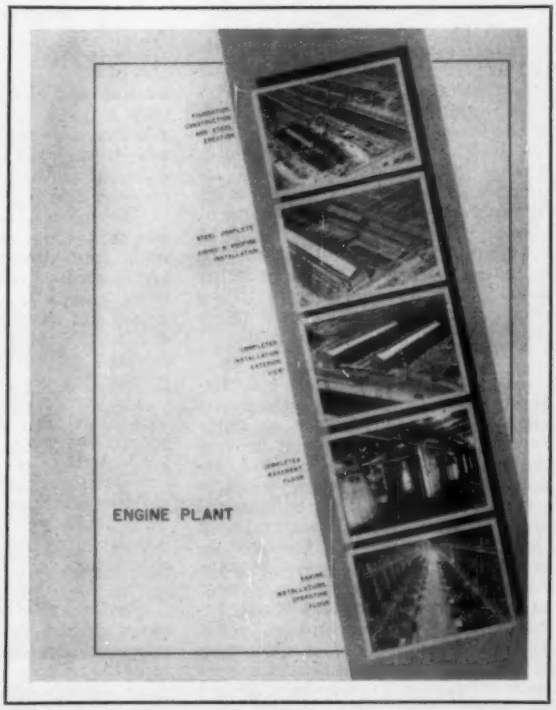


Fig. 4. Standard form used by Kaiser Engineers for presenting construction photographs for each of their projects

these facts available for quick reference.

A basic underlying pattern is followed in preparing these descriptions. Buildings and structures are mentioned first followed by the equipment that is housed within the structures. The detailed discussion of the equipment follows the same sequence as the process flow. By means of this simple coupling device it is possible to describe the equipment and its function simultaneously with a description of the industrial process involved.

Frequent use is made of sizes and capacities in order to give the reader an immediate mental image of the sizes of the equipment. For instance, most people will visualize a 225-ton crane used in a steel mill as a heavy duty crane, while a 10-ton or 15-ton crane is pictured as a light-weight service crane that is common to many industrial buildings.

In the case of electric motors, the horsepower, voltage and revolutions per minute are important to the reader for reference use as well as for descriptive purposes.

In preparing this section the general specifications promulgated by the engineering department at the beginning of the project are used as the guide. These original specifications are checked against actual installations as the job progresses. In addition, frequent use is made of the final drawings to insure a positive check on the accuracy of the final report description.

Notes on Engineering: — This section is devoted exclusively to the engineering and design phases of the project. It is generally brief, and serves as a reference of those who were responsible for the engineering, of the starting and completion dates for design work, and of the noteworthy design considerations, aspects, and problems. Unique design features or unusual engineering problems and their solutions are described in greater detail. The criteria for including a subject in the engineering notes is the probable interest to the client or to another engineer interested in designing a similar plant.

Notes on Procurement and Expediting: — This section closely parallels the preceding notes on engineering. It lists the responsibilities of the assigned procurement and expediting personnel, shows the dates when the principal items of material and equipment were procured and the total volume of purchase orders. A large portion of this section is devoted to those items of equipment or construction materials which required the greatest attention by the expediting department. A discussion is included of any difficulties that were encountered in meeting delivery dates through strike action anywhere along the line of supply, through shortages of material or in obtaining approvals from federal agencies if such approvals were required.

Notes on Construction: — This section contains two parts: a narrative description of the construction progress, and the construction program in bar chart form.

The descriptive part begins with a list of the key construction personnel and their responsibilities which is followed by a description in general terms of the chronological sequence of construction. Key dates, such as initial construction of various phases of the work and the initial operation of key elements of machinery are mentioned. Any unusual problems that were encountered in the construction phase are described in greater detail.

The construction program is in horizontal bar chart form, as shown in Fig. 3, listing the major items included in the project with the bars designating the actual time of construction. Also shown on the chart are the initial operating dates for the key sections of the plant. This chart is designed to give a visual correlation of the sequence of construction and to tell the reader at a glance when the various phases of the project were completed.

Progress Charts: — This is generally a three-part section containing a chart showing the labor force, a chart showing the recorded costs (Fig. 2), and a third chart showing the construction quantities (Fig. 1).

The force chart is started with the beginning of the job and is plotted on a day-to-day basis throughout the life of the project. The mandays worked are plotted on the vertical scale which gives a skyscraper effect and indicates the intensity of project as it moves to completion. Important dates of the project are shown by notes on the chart.

The recorded cost chart contains two curves, one showing the monthly costs and the other showing the accumulative costs. This arrangement gives a ready reference to the amount of the monthly expenditures and to the total cost of the project during its construction and at completion.

The construction quantities chart is included only when the size of the project warrants it. Only key items are included such as excavation, concrete, reinforcing and structural steel. Both monthly and cumulative quantities are shown to give an immediate measure of the intensity of construction.

Photographs: — This is the picture story of the project. Kaiser Engineers has developed a format which is designed to show briefly the progress of construction from beginning to end. Five pictures are mounted on a page with descriptive captions at the left, as shown in Fig. 4. When a project is large enough to require a series of picture pages, the first is generally a summary, showing exterior or aerial views of the plant from the undeveloped site to the completed facilities. Succeeding pages are then devoted to equipment items within the plant so arranged that the sequence of the pictures follows the process flow through the plant. Key dates in connection with construction are entered along with the appropriate photograph. The date the photograph was taken is always shown whenever possible.

The source of these photographs may be commercial photographers, company photographers or informal photographs taken by arrangement with construction personnel.

General Drawings: — The general arrangement or layout drawings that are included in the final report are selected on a basis of their over-all reference value for the reader. The original 27 in. x 40 in. drawing is reduced by film negative to 11 in. x 17 in. brownline prints.

Only a limited number of copies of the completed final report is reproduced. The distribution is confined to the client and to key personnel in Kaiser Engineers.

ARF—20 Years Old

THIS YEAR marks the 20th anniversary of the founding of Armour Research Foundation of the Illinois Institute of Technology. This not-for-profit research organization began operation April 3, 1936 with a small staff and a two-sponsor pledge that totaled $20,000.

By contrast, the Foundation today performs an annual research volume of approximately $11,000,000, and employs a staff of 1100 full-time scientists, engineers and other specialists, who work on more than 500 industrial and government projects each year. Laboratories and offices now occupy 15 buildings at Technology Center, the name given to Illinois Institute of Technology's rapidly growing campus. The Foundation's operations, however, have no geographical limitations, and a number of laboratories are maintained overseas.

Idea of a research institute for the benefit of industry was originated by the board of trustees of Armour Institute of Technology (now Illinois Tech) in 1930. The board knew that while large industries forged ahead on their own research, countless small business officials lacked initiative, equipment, and funds for such work. Unlike many of its sister organizations, however, Armour Research Foundation did not spring fully-armed from a huge endowment. In-

stead, the founders were determined that its success or failure would depend upon its value to the industries and the nation it was to serve. Since its formation, the Foundation has conducted approximately $70,000,000 in research on some 3000 projects in almost every conceivable field.

A number of events will be sponsored by the Foundation during 1956 — its 20th year — to show the importance of industrial research to the nation. One of these events will be the first annual National Industrial Research Conference at the Sherman Hotel in Chicago on April 18 and 19.

Glass Block Walls Give Maintenance-Free Daylight

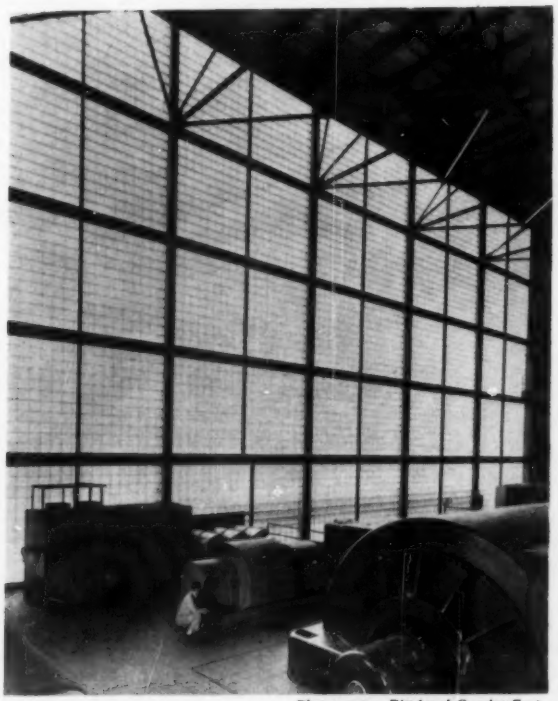


Photo courtesy Pittsburgh Corning Corp.

Five-story glass block walls at Philadelphia's Cromby station

AT PHILADELPHIA ELECTRIC'S new Cromby Station, many lighting problems have been solved by glass blocks used as major wall sections, as shown in the accompanying illustration.

Glass block panels were chosen because they would give best lighting combined with high insulation value, eliminate sash replacement, and reduce the window maintenance caused by storm, damage, rust, and corrosion. They are expected to last as long as the building itself.

With ordinary windows, glare would often be blinding, but the built-in prisms and corrugations of the glass blocks serve to control and diffuse the light. In addition the hollow blocks have the insulating value of an 8-in. masonry wall.

With conventional windows in buildings of this size the only way to get at the windows is with extensive scaffolding — a costly operation. Glass blocks, however, clean themselves with the washing action of normal rainfall.

As conventional window sash becomes older it begins to wear and becomes difficult to close properly. Leakage causes further damage and constant vigilance is required for broken window sections. When broken window sections are discovered, once again scaffolding is needed for their replacement.

With normal windows, most of the station ventilation is supplied by opening and closing windows. However, when rain or high winds made it necessary to close the windows, ventilation is impeded. At Cromby station the ventilation system has special louvers to give ideal ventilation conditions at all times, regardless of outside conditions.

Formosa Has 5-Year Power Expansion Plan

ONE of the free world's most important power development programs entered its latest phase with the announcement that Taiwan Power Co. will add a 44,000-kw extension to its newly completed Nan-pu steam electric generating station at Kao-hsiung, Taiwan (Formosa). The Nan-pu extension will represent an important part of the company's five-year $100,000,000 expansion program. The program was started in 1953 for completion in 1957 to add 300,000 kws to this strategic island's installed generating capacity which, in 1952, was 320,000 kws. The new Nan-pu installation will cost approximately $7,000,000. A loan of about $5,000,000 has been granted to Taiwan Power by the International Coöperation Administration to be used in its entirety for the purchase of equipment, all major items of which will be of U. S. manufacture, to defray equipment shipping charges to Kao-hsiung, and to cover engineering fees. The extension's construction will be undertaken and paid for by Taiwan Power. Gibbs & Hill, Inc., New York consulting engineers who designed and supervised construction of the original Nan-pu station, have been retained to design the extension. The equipment will be purchased through the Central Trust of China, fiscal agency of the Republic of China, with Gibbs & Hill, Inc. acting as its agent for procurement.

New unit will generally duplicate the original Nan-pu plant which went into service on November 21, 1955. Extension is a pulverized-coal-and-oil-burning steam electric station rated at 44,000 kw, maximum, with an 850-psig, 900-F., 13,800-v, 3-phase, 60-cycle, 3,600 rpm. condensing turbine generator served by a single boiler and accessory equipment. The boiler will furnish 425,000 lb of steam per hour at a temperature of 910 F., and a pressure of 885 psig.

Under the five-year program, the added steam electric capacity will total 132,000 kws while 169,850 kws will be hydroelectric. K. S. Yeh, Taiwan Power's director of steam electric projects, said this phase now is being given prominence because of its function which is to supplement the system's hydroelectric facilities, and to provide the needed large blocks of power in minimum time.

As part of the steam electric phase, an addition was recently made to Taiwan's Pei-pu station in the north about 25 miles from Taipei, the island's capital city. The Pei-pu plants now furnish a total of 82,000 kw to the Taiwan system.

Taiwan Power Company is 91 per cent owned by the Republic of China, and 9 per cent by the public. The company was formed at the close of World War II to take over all the power facilities on Taiwan and the nearby Pescadores and rehabilitate the system.

This Is the Way You Pull a Generator Rotor—II

This is the eleventh article in a series describing the scheduled overhaul of a 25,000 kw turbine generator at U. S. Steel Corporation's South Works in Chicago. Last month we described first steps in removing the generator rotor. Here is the rest of the operation

LAST MONTH we described preliminary moves in withdrawing the generator rotor up to the point where the exciter end of the rotor was supported in its pedestal bearing, seen in Fig. 1, and the turbine end of the rotor was supported by the main crane as shown in Fig. 2.

With the rotor in position shown in Fig. 2, the rollers of the special bracket on the rotor were directly over the sheet steel pan previously laid on the stator laminations. Next move was to lower the turbine end of the rotor so the bracket rollers would rest on the pan, as shown in Fig. 3, and remove the crane sling.

Then, with one end of the rotor resting in its journal (with the pedestal moving on rollers) and the other end rolling on the sheet metal pan in the stator, the rotor was withdrawn. The rotor was actually moved by means of the crane sling, seen in Fig. 4, with the pedestal being moved separately at the same speed as the rotor. Rotor and pedestal bearing were moved separately because friction is small between a shaft and its journal, and if the rotor was moved by pulling the journal alone there would be danger of the bearing sliding away from the shaft.

When the rotor was nearly out, a double sling was placed around the rotor body. The sling was adjusted so the whole weight of the rotor would be lifted by the crane. Figure 6 shows this stage of the operation. Note the spirit level on the shaft. The level was put there while the sling was being adjusted to make sure the rotor would remain exactly horizontal while being lifted clear of the generator, as shown in Figs. 7 and 9.

It is very important that the rotor remain exactly horizontal while being lifted clear of a generator to make sure it does not swing and damage the exposed stator windings.

Once the rotor was clear it was set down on blocking where it could be inspected, tested and cleaned.

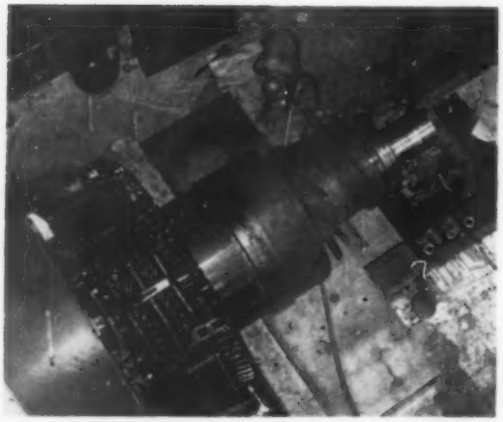


Fig. 1. Above. Shows exciter end of the rotor supported by its bearing, which moves on rollers, while in Fig. 2, below, turbine end of the rotor is moved by crane until sling reaches the stator winding. In this position the bracket (Fig. 3) is over the pan so the rotor can be lowered on to it

Fig. 3. Weight of turbine end of rotor supported by bracket and rollers. Pan distributes weight over large area

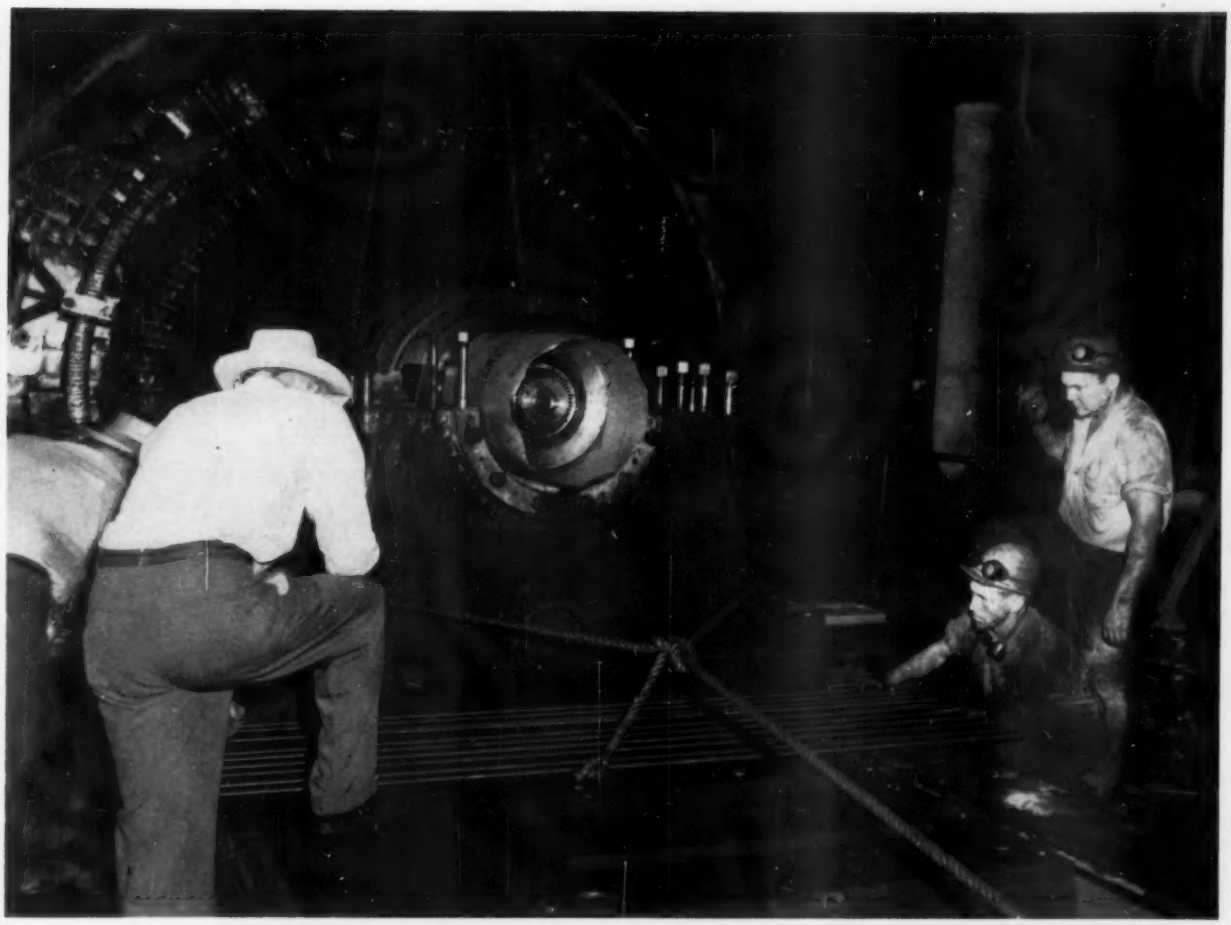


Fig. 4. Rotor on the way out. Note that the crane is taking the weight of this end of the rotor. Pedestal bearing is being moved separately. The steel pan distributes weight of turbine end of rotor which is supported by bracket and rollers (Fig. 3)

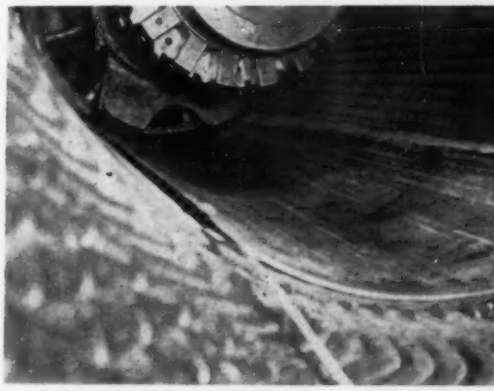


Fig. 5. Shows turbine end of rotor almost out of stator. Rotor weighs 51 tons, and without the pan the stator would be damaged by the rollers

Fig. 6. When rotor was nearly out, a double sling was used to lift whole weight of rotor. Arrow points to level on shaft to make sure rotor is exactly level

When all these articles have been published, the series will be reprinted. Here are some ways the reprints can be used:

1. To train young engineers.
2. To brief new men before an overhaul.
3. To show management why so much time is needed for an overhaul.
4. To illustrate parts when discussing any turbine generator problem.

If you want one or more reprints write to the Editor.

Fig. 7. Above. Rotor supported entirely by double sling. Pieces of leather belting under sling prevent damage

Fig. 8. Right. Rotor clear of the stator. This photograph shows how the sheet steel pan protects stator lamin[illegible]ons

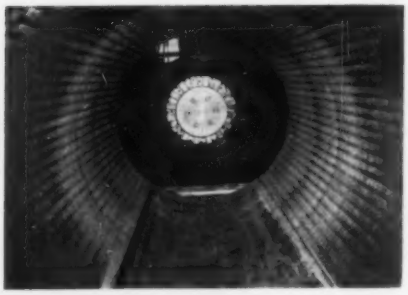
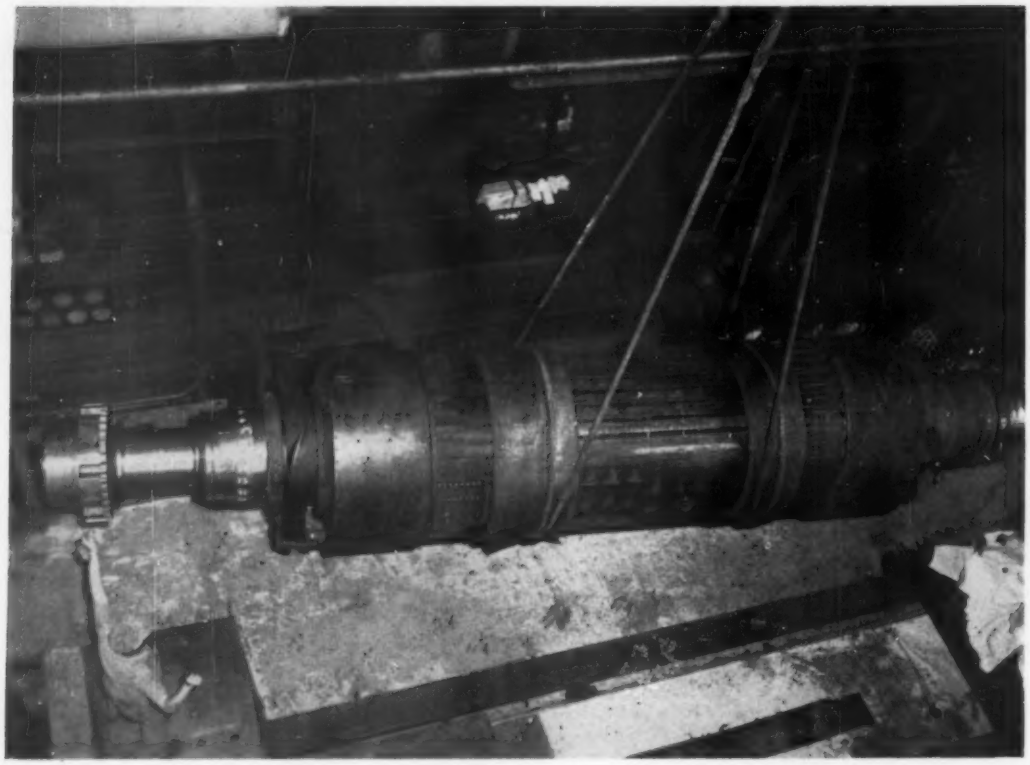


Fig. 9. Below. Once the rotor was clear of the stator it was taken to the maintenance bay to be cleaned and overhauled. When the stator had been repaired and cleaned the rotor was replaced by reversing withdrawal procedure



What's the Best Way to Blow Out Turbine Main Steam Lines?

Forty-one companies recently cleaned their turbine main steam lines by blowing them out with steam before initial start-up. Here is a summary of their experiences, conclusions, and recommendations

CLEANING MAIN steam lines by blowing them out with steam before first operating a turbine has become increasingly important during the past few years. Companies which had previously relied upon blowing with compressed air or on inspection have generally found that these methods did not produce satisfactory results.

One turbine manufacturer has numerous photographs of machines after less than one year's operation which show a steam path appearance of a 15- to 20-year-old unit as a result of the shot blast effect caused by fine foreign particles. Although the need to blow out steam lines is now widely recognized there has been little unanimity of practice. A knowledge of the blowing out procedures followed by other companies, and the results obtained, should be helpful in developing satisfactory techniques for this important operation.

All of the 41 companies stated that blowing out lines is a practical method of cleaning, but some indicated that the results have not been entirely satisfactory. Although all the companies are planning to continue the practice with future installations, quite a few are contemplating changes in procedure. Here are details of the experiences of these 41 companies.

Preparation for blowing out operation: Seventeen of the units cleaned were nonreheat installations; 24 were reheat.

Temporary piping arrangements for blowing out the main steam piping for the 17 nonreheat units followed a common pattern. The turbine stop valve bonnet was replaced with a temporary flange to which was connected piping to exhaust the dirty steam to the atmosphere. The temporary piping was usually sized equal to or larger than the main steam piping.

In four of the installations, valves were installed in the temporary piping to control the blow out flow. In the other installations, the boiler stop valve or other permanent valve in the main steam line was used.

Blowing out operation — Control of blow: All but 12 of the companies controlled the blowing with the boiler stop valve or other permanent valve in the main steam line. Most of the companies who used temporary valves did not have any appreciable difficulty in operating them.

The time of opening or closing the valves ranged from 15 sec to 10 minutes. Some companies opened the control valve as fast as possible and then closed it before the boiler water level got out of hand. Other companies opened and closed the valve very gradually in order to limit changes in the water level. Practically all the companies had some difficulty with the water level.

Drum pressure: Drum pressure reached at the start of blowing through the main steam line ranged from 100 to 800 psi. Five companies started blowing with drum pressure below 250 psi, five between 300 and 350 psi; eleven between 400 and 450 psi, ten between 500 and 580 psi, eight between 600 and 620 psi, and one company each at 700 and 800 psi.

All but six of the companies allowed the pressure to drop during the blowing operation. Final drum pressures ranged from 0 to 500 psi. Pressure drop during the blowing out varied from 50 to 600 psi and averaged about 200 psi.

Length and number of blows: Many of the companies made several relatively short blows of about two to five minutes duration. As expressed by one company, a series of short blows was felt to be most effective so long as each blow was long enough to heat the steam lines. Several companies made blows 10 to 15 minutes long.

Most of the companies stopped a particular blow soon after the discharge cleared up, or when the drum pressure had dropped to what was considered to be a minimum effective blowing pressure. In the case of reheat installations, several companies made only one or two blows through the main steam line alone because subsequent blows through the reheat lines passed through the main steam line.

Time between blows: The time taken between blows in a particular blowing sequence was determined in most cases by the time required to restore the boiler pressure and to establish the desired water level. About half the companies were able to repeat blows within 30 minutes. Nine companies took less than ten minutes, and only four took longer than one hour. A considerably longer time was normally required between blowing sequences because of the time required to make piping changes.

Magnitude of flow: Several companies stated they considered an adequate flow through the steam pipes to be more important to the cleaning operation than temperature changes. Twelve of the 41 companies compared the flow obtained during the blow out with the flow for normal full-load operation. All of these companies exceeded the normal full-load velocity in blowing out. Two companies stated they also exceeded the full-load weight flow. The product of the full-load velocity and weight flows was exceeded by seven companies.

There was considerable difference of opinion as to whether velocity, weight flow or their product have the most effect in moving particles.

Noise: One company reported that the noise during the blowing period was heard by an employee five miles away. Several companies measured the noise level in the vicinity of the plant. One reported a noise level of 108 to 117 decibels 500 ft away in line with the issuing steam and 78 decibels 1000 ft away. Ambient noise ranged from 55 to 62 decibels.

Another company reported a noise level of 129 decibels 100 ft away and at right angles to the exhaust pipe.

Most of the plants were located in isolated or rural areas where the noise did not matter. Where plants were located close to populated areas local residents were sometimes warned. It was general practice not to make blows at night when people were sleeping.

Foreign material dislodged by blow: Only a few companies attempted to catch foreign matter dislodged during the blow. One company, by installing fine mesh screens over the standard screens in the turbine stop valve, caught about nine grams of miscellaneous matter including weld beads, parts of nails and several small pieces from the end of a tube roller mandrel. Another company caught material by means of a screen installed over the end of the discharge pipe, and another caught material on a canvas.

Many companies reported a considerable amount of foreign matter ejected during the blowing operation. Many companies reported that the discharge was dark for a period at the start of particular blows. In some cases, solid objects were observed in the discharge steam or were found on the ground after the blowing period.

Material discharged included weld beads, pieces of welding rod, metal shavings, mill scale, iron oxide, slag, wire, rust, rags, and in one case a piece of 2 by 4, one ft long, was blown out of a reheat line.

Many companies inspected the piping after the blowing out operation and reported that generally it appeared to be clean and free of any foreign matter. However, a few companies found a sludge or accumulation of particles such as scale weld beads and slag at dead end sections adjacent to the temporary pipe connections. Others found small amounts of scale and miscellaneous particles in the turbine stop and intercept valves.

In the case of about two-thirds of the reheat units, and prior to their initial operation, fine mesh strainers were installed temporarily in both the turbine stop and intercept valves. Only two companies, however, installed fine mesh strainers in the turbine stop valves of nonreheat units.

Probably fine mesh strainers are more frequently used with reheat units because of the greater difficulty of achieving a really effective blowing out. All but one of the companies installed the strainers after the blowing out operation.

The strainers used were made of stainless steel having $\frac{1}{32}$ in. openings in most cases and $\frac{1}{16}$ in. in a few other cases. It was general practice to install the fine mesh strainers over the permanent strainers.

Many companies considered the fine mesh strainers a necessary additional precaution regardless of the removal forces obtained during the blowing out.

Twenty-seven companies reported that steam strainers had been inspected after a period of operation under load. Seventeen of the 27 found considerable material for which blowing out had evidently been ineffective in removing from the system.

The considerable amount of foreign material which was found in strainers after a period of operation indicates that blowing out is, in the case of many companies, not yet a completely effective method of cleaning. The larger pieces found in the strainers might have been removed during the blow if removal forces had been greater and maintained for a longer period.

Although present techniques followed in blowing out steam lines have not, in many cases, been fully effective in removing all foreign material from the lines, none of the companies are contemplating a substitution of internal mechanical or chemical cleaning for the blowing-out operation. The opinion was generally held that piping should be thoroughly cleaned by mechanical or chemical means during fabrication and that proper care and protection of the piping during transit and erection contribute a great deal to the internal cleanliness of a finished piping system.

Contemplated changes in blowing out procedure: Although all the companies consider that blowing out steam lines is a practical method of cleaning them, many have not been entirely satisfied with the results obtained. It is generally felt by these companies, however, that this method of cleaning will produce the desired result if sufficient time is made available and the proper procedure is followed. Twenty-three of the companies are considering making changes in their present procedures.

The desirability of increasing the removal forces, particularly in the reheat lines, is widely recognized. Fifteen companies are considering changes directed to this end. Several plan to increase the size of, and if possible shorten the length of, the temporary piping.

One company plans to increase the velocity through the superheater by making at least one blow of the main steam piping at drum pressures low enough to permit the boiler stop valve to be wide open. Another will use a number of repeated short hard blows to clean pendant superheater loops. One company will attempt to do a better job in cleaning the reheater and reheat lines by blowing these lines individually and possibly at higher pressures. Another will blow reheat lines closer to design pressure.

Several plan to blow reheat lines at a higher velocity by using larger discharge pipe and, in some cases, a higher firing rate to maintain sufficient blowing pressure over a reasonable period of time. Five companies plan to modify their procedure in order to obtain a greater temperature change in the lines during the blowing-out operation. Generally, the time between blows will be increased to allow the piping to cool as much as possible to loosen mill scale.

Conclusions and recommendations: The survey indicates that blowing out steam lines to remove loose material before starting a new turbine is generally considered to be practical, desirable, and even necessary.

There is obviously no procedure which will fit all cases. However, after an analysis of the data collected, it appears that the following items represent good practice and may be used as a basis for working out a procedure for a particular installation.

1. Temporary piping: Temporary piping should be large enough to permit adequate flow through the main steam line. If shut-off or flow control is needed in the temporary piping, two valves in parallel should be considered in place of one large valve for easier and faster operation.

2. Drum pressure during blow: Adequate removal forces can probably be attained by firing at a rate to maintain a drum pressure at 20 to 30 per cent of that for rated full load.

3. Length of blow: If the boiler is fired to maintain the drum pressure during the blow, the control valve or valves must be opened sufficiently slowly to avoid carry-over of water into the superheater. Five to ten minutes may be required to obtain the desired magnitude of flow and establish proper feedwater flow and firing rate to maintain the drum pressure constant. The removal forces should be adequate if the pressure drop across the superheater during the blow exceeds by a margin the expected pressure drop for full-load flow.

4. Number of blows: For reheat units the number of blows may depend on the blowing sequence for the main steam, cold reheat and hot reheat lines. The number of blows through the main steam line may be reduced initially if subsequent blows through the reheat lines pass through the main steam line.

It appears that a minimum of two blows should be made in each section in order to take advantage of the effect of temperature changes in loosening scale. For example, a minimum blow schedule for a reheat installation would be one blow through the main steam line alone, one blow through the main steam line and cold reheat line, and two blows through the entire system, i.e. the main steam line, cold reheat line and hot reheat line.

A guide may be made by installing a piece of polished key stock in the temporary pipe before each blow. The appearance of the surface of the key stock will give an index to the progress of the cleaning.

5. Time between blows: There seems to be no reason why blows in a particular blow-sequence should not be repeated as soon as the drum pressure and water level have been restored. Waiting longer between blows to obtain maximum temperature change would be very slow because of the slow cooling rate of insulated pipe.

6. Fine mesh strainers: The use of fine mesh strainers during the initial operating period is an inexpensive additional safeguard and is recommended. Regardless of the magnitude of the removal forces during blowing-out, there can be no certainty that the system has been

thoroughly cleaned. It is reasonable to expect that some material will be dislodged during the first few days of turbine operation.

7. Protective practices to supplement blowing: Blowing out is not considered to be a substitute for careful inspection and cleaning during the erection of the boiler and main steam piping. The piping should be pickled, and sand-blasted at the fabricator's shop. Openings should be adequately sealed during shipment and storage.

Particular attention should be given to the turbine steam leads, steam chests, control valves and primary nozzles as these components are not included in the steam blowing path. Severe damage from these sources can nullify all the effects of a carefully designed and executed blow out procedure.

A final caution is not to forget foreign material in steam lines after the turbine has operated successfully for a period. Superheater repairs and welding work on tubes or piping in the steam system can result in damage unless proper precautions are taken.

The above material is taken from a report of the Turbines and Condensers Subcommittee of the Prime Movers Committee, Edison Electric Institute.

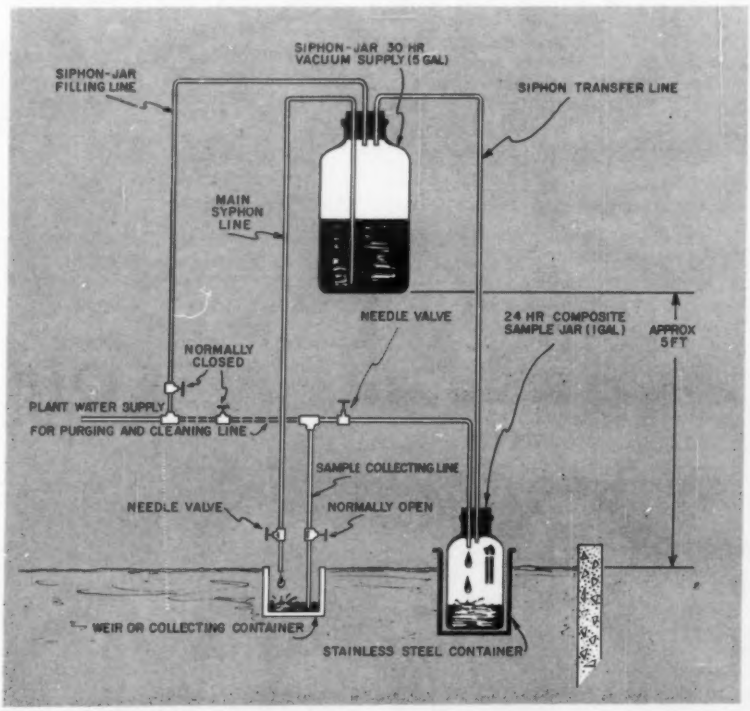
Automatic 24-Hr Effluent Sampler Is Simple, Easy to Make

THE NECESSITY OF sending out men every hour to collect samples of trickling filter effluent at their waste treatment plant bothered A. E. Dolynko, Supt. of Utilities at General Motors new Technical Center in Detroit. He decided to do something about it, and the ingenious automatic sampling system shown in the illustration is the result.

To operate the system, the large 5-gal. jar is filled with water and the main siphon line primed to draw water from this elevated container. Water siphoning out of the large sealed siphon jar tends to draw a partial vacuum; but, since the sample jar and siphon jar are connected by the siphon transfer line, low pressure also exists in the sample jar and therefore effluent is drawn into the sample collecting line and thence into the sample jar itself. Flow rate can be adjusted by proper settings of the needle valves in the siphon line and sample collecting line.

At the GM Technical Center, the flow (or drip) rate is set to almost fill the 1-gal. sample jar in 24 hours.

Dolynko found it necessary to place the sample jar in a stainless steel container that was immersed in the effluent; the jar contents are thereby always maintained at effluent temperatures. If this is not done, sample tests may give misleading results due to the difference in biological and chemical activity at different temperatures.



Automatic effluent sampler is easily made. In actual use, the pipes or tubing would be connected to the sealed jars with rubber hose to facilitate handling and removal of the containers. Rubber stoppers in jars must tightly seal both jar tops and inlet tubing. Mount siphon jar about 5 ft above collecting point

High-Altitude High-Voltage Test Line

MILE-LONG extra-high voltage electric transmission test line, located 10,300 ft above sea level, will be constructed by the Public Service Company of Colorado at its Leadville Substation. Construction of the test line was started this summer by Public Service Company crews, and first tests are scheduled for the spring of 1956.

The test line is being built to determine operating conditions including corona losses and radio influence at high altitudes. The data will be compared with that already obtained at low altitudes, so that suitable designs for high voltage lines at altitudes from 5,000 to 12,000 ft can be developed.

The tests will be made under a wide variety of weather conditions on both single and bundled conductors of various sizes throughout a range of extra-high voltages approaching 500,000 v. Both wood-pole and steel-tower construction will be used.

Several electrical equipment manufacturers are cooperating in the tests. Westinghouse Electric Corp. will supply transformers, and instrumentation for corona-loss and radio influence measurements on the new test line as well as providing lightning arresters, and disconnect and grounding switches for the installation. Aluminum Co. of America will supply conductor cable for the tests. Substation and line structural equipment, line hardware, and insulators will be supplied by U. S. Steel's American Bridge Division, Hughes Brothers, Inc., Malleable Iron Fittings Company, and Ohio Brass Co. Engineers from Public Service Company and Westinghouse will perform the tests, recording data, and evaluating results in cooperation with the engineering departments of the other manufacturers.

Reducing Power Plant Maintenance Costs

Here are some of the ways maintenance costs are being reduced by three large utility companies. Large savings are possible by reducing maintenance costs. Problem is how to achieve these savings

Philadelphia Electric Co.

LARGEST item of power production cost is fuel, over which cost a utility has very little control. This leaves supervision, engineering, plant operating labor, supplies and expense, and maintenance as fields in which to make savings. In a large steam system maintenance can be 50 per cent of these costs. Reduce maintenance costs and you reduce power production costs.

Here are some ways of reducing these costs, described by W. F. Oberhuber and C. W. Watson in ASME Paper 55-A-128.

Original Design: This establishes maintenance pattern. Much maintenance time can be saved by incorporating repair features in original design. Authors advocate economic analysis of such questions to see if increased capital costs are justified by resultant maintenance savings.

Management policy: Guiding policy should be production of power at lowest *overall* cost and not necessarily lowest maintenance cost.

Planning: Once equipment is installed, general maintenance pattern is set, so for maintenance savings jobs must be carefully planned. They first prepare annual schedule of major equipment inspections, then detailed work sheets in which highest priority is given to the limiting job. They have found it pays, when opening up equipment, to have men available on the job who might be needed for unknown repairs, even though the repairs turn out to be unnecessary when the equipment is actually opened up. They have also found it pays to remove potential causes of failure when equipment is out of service even though it may not be strictly necessary at the time.

Their maintenance organization consists of a Superintendent's Staff, a Production Stations Group, a Central Shops Group, and a Mobile Group. The Superintendent's Staff contains a technical group, a planning and cost analysis group, and a trades training and testing group. The Production Station Group consists of a group of skilled tradesman at each station. The Central Shop Group has all the specialized machines and highly trained men at a central location for investment economy and efficiency. The Mobile Group, in two sections, one electrical and one mechanical are organized with supervision, specialists and suitable mobile equipment.

Cost Accounting: Units of equipment are given account numbers so a comparison of maintenance costs can be made not only between stations but between corresponding pieces of equipment in the same plant.

It is necessary to accumulate cost data over a long period to minimize effect of special cases.

Union Electric Co. of Mo.

MAINTENANCE starts with liaison between design and operating groups. For example, furnaces, pulverizers and ash systems should be adaptable to the declining quality of fuels — the point where much maintenance starts; lubricating systems are simplified and assigned to special experts to service and maintain; building layouts are made with aisles, hoist bays, hoist rails, elevators, ramps and shop locations suited to economic maintenance. Roadways for lift trucks reaching draft equipment are an example.

Close liaison is necessary between operating groups and designers. G. V. Williamson, in ASME paper 55-A-174 tells how the control room for one of their new plants was made up completely with models, and a committee from design and operations spent considerable time before final layout was made. Result was a layout efficient in final design.

Maintenance program: In setting up maintenance program objectives are:

1. Properly sized, equipped and trained maintenance dept.

2. Reduction of overtime, but sometimes heavy maintenance overtime gives best overall economy. No overtime at all can indicate extravagance.

3. Change in maintenance method to increase availability, reliability or capacity of equipment.

4. Establish a maintenance program for each unit of equipment. They consider four types of maintenance.

Breakdown: Maintenance work done only on equipment after failure has occurred.

Scheduled: Periodic maintenance and repair.

Test: Tests of high accuracy to indicate internal conditions.

Preventive: Term preventive maintenance often misused. Loosely, preventive maintenance may mean periodic inspection and maintenance to avoid outages at all costs. Real preventive maintenance should give lowest overall cost for maintenance. Union Electric uses scheduled and test maintenance.

Cost control: Important points are complete records, largely kept by plant maintenance personnel, full cost accounting system handled by IBM system. Separate maintenance engineering dept. working on time sheets, manhour performance, and studying maintenance problems from point of view of plant organization and technical guidance. Feature is monthly discussion between maintenance cost engineer and representatives of plant maintenance organization of each plant.

Pacific Gas & Elec. Co.

MODERN design has changed maintenance a great deal. High temperatures, pressures, and speeds make for more difficult maintenance and machines that can stand less abuse than smaller and older ones.

Larger and more efficient units makes outage time more expensive. In example quoted by V. F. Estcourt as reported in ASME paper 55-A-87, an increase of only 100 outage hrs at a replacement power cost of $200 per hr would be equivalent to a reduction in heat rate of approx 95 Btu per gross kwhr. This would be equal to approximately $170,000 for a 100 mw unit.

Plant management: Good judgment needed to determine when to repair, replace, and the degree of work to be done in each case.

Planning: This includes preparation of outage schedules. Decisions must be calculated in terms of possible risk of forced outage of main unit due to loss of a major auxiliary.

Technical management: Greater complexity of modern equipment calls for higher technical knowledge in management at the plant level. Present university training could be improved for those entering the field of power production. Greater emphasis should be placed on the phases of electrical engineering which are of special importance in the power field. More chemistry and metallurgy are needed, and a higher level of thermodynamics. Universities and utilities need to get together to orient both the faculty and the student to the basic technological problems in this rapidly growing industry.

Pre-Cast Insulated Stacks Can Handle All Fuels, Temperatures to 1600 F

If you are faced with the job of installing a new stack up to 24 in. diameter, consider a pre-cast refractory stack before you decide. It might have the combination of cost, convenience, life, and low maintenance you need. It's a refractory pre-fab at cost of steel

ECONOMIES and convenience of prefabrication have finally caught up with refractory stacks. One manufacturer has started producing these stacks as industrial units in sizes from 10 to 24 inches (ID) similar to but larger than the domestic chimneys they previously manufactured.

The new unit is an all-fuel refractory stack for use where flue gases do not exceed 1600 F. This extends its use from boilers to furnaces, ovens, retorts and incinerators. Sections are about three feet long and are assembled into a complete stack by cementing with an acid-resistant, high-temperature joint cement. Each section consists of a vermiculite concrete insulating wall and an aluminum outer jacket, designed to eliminate maintenance and painting. Aluminum joint bands, installed with sheet metal screws, make the joints tight and add strength to the assembly.

Sizes to be produced (ID) are 10, 12, 15, 18, 21, and 24 inches. Since they are factory-produced, they cost only about one-third as much as comparable brick stacks, but about the same as steel. Since there is less heat loss, the insulated refractory stack will produce greater draft than the steel stack. The manufacturers predict about three times the life of steel stacks for their unit.

Weights per foot run from 37 lb (10-in.) to 125 lb (24-in.). Footings are supplied by the purchaser, and supports (see Fig. 1) should be figured for the individual jobs.

For information on availability and specific data, jot "Pre-Cast Stack" on the prepaid post card in this issue and mail it to us.

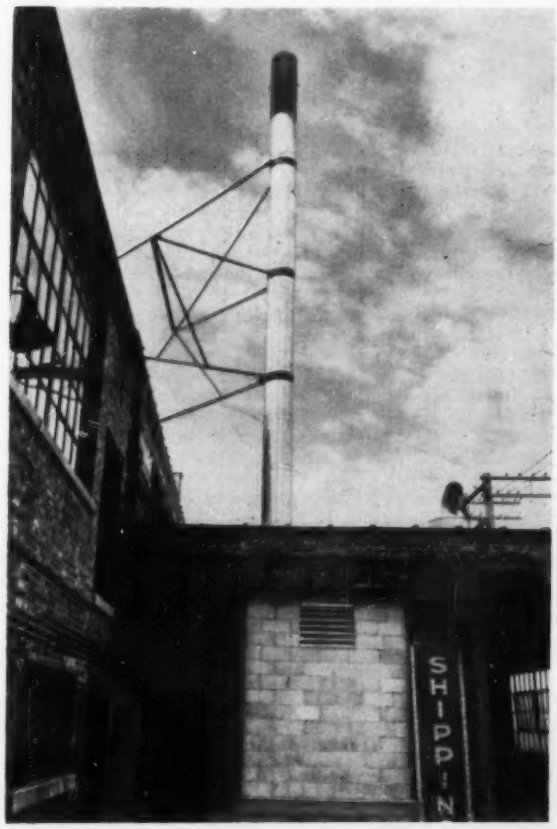


Fig. 1. Outside installation of the new pre-cast stack. The aluminum jacket needs no painting, virtually no maintenance

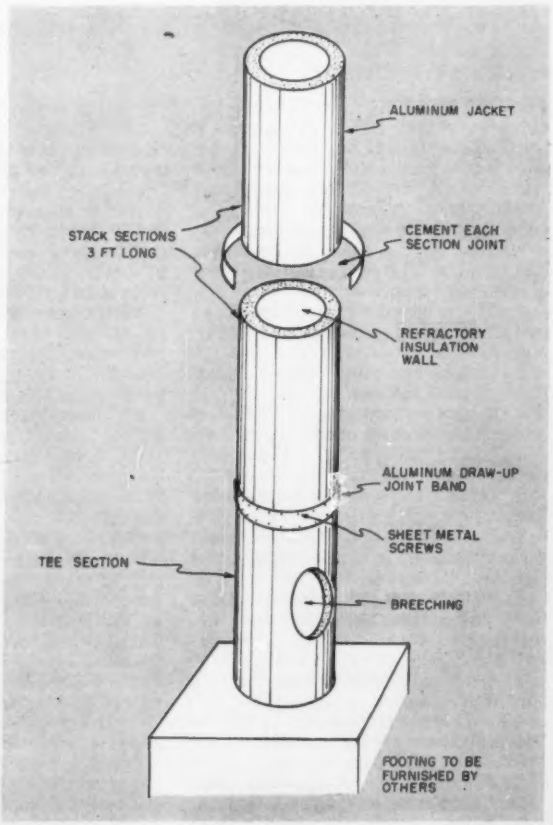


Fig. 2. Stacks are assembled from the components shown here. Bracing must be designed to fit individual locations

The Why and How of Steam Trapping

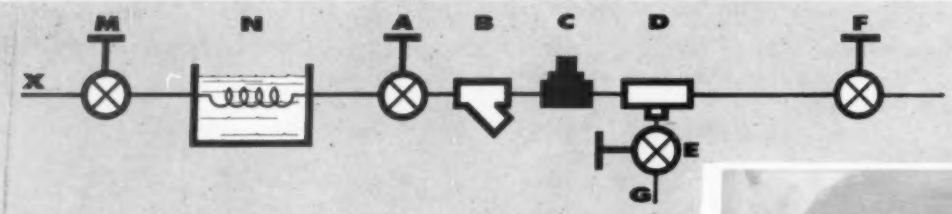


Fig. 1. Above. Basic trap hook-up. Trouble-shooting tests given in text

Fig. 2. Right. Taking in and out trap temperatures with contact pyrometer

This is the third and last article in the present series on steam traps. In December types of traps were explained and last month their selection, sizing, and applications were discussed

By JOHN W. WELKER*

INSTALLATION must be correctly made to take full advantage of a trap. This must be followed by adequate preventive maintenance schedules. A list of installation instructions below can be used as a general guide to good trapping.

1. Carefully check piping and blow it out under full steam pressure before connecting traps.
2. Check flow directional arrows or markings on trap bodies or nameplates.
3. Install a Dutch weave mesh strainer ahead of each trap.
4. Install test valve at a "T" fitting in discharge line to check operation.
5. Install traps at accessible locations.
6. Install traps where possible at lowest points in system.
7. Install traps (except thermostatic types) as close to equipment as possible.
8. Install shut-off valves on both inlet and outlet to enable isolation for maintenance purposes when required.
9. Trap each coil or each heating unit individually.
10. Where condensate is to be lifted above the trap, install a check valve between trap and riser.
11. Install only self-draining traps when they are subject to freezing conditions.
12. Pitch horizontal inlet lines to traps to keep them full of condensate and avoid steam binding.
13. When a group of traps discharge into a common header, install a check valve between each trap and the header to prevent reverse flow during shut-down.
14. Install larger traps on the first and possibly second coil of a number of coils which are in series with respect to air flow through them.
15. Be sure return line is no higher above trap than the level to which the lowest line pressure can lift condensate. Multiply lowest line pressure by 2 to determine maximum height.
16. Install unions on both sides of a trap to facilitate removal.
17. Never use piping smaller than the connections to the trap.
18. Keep return line piping large enough to prevent excessive back pressure. Use Fig. 3 to determine return line size. Enter chart from left at orifice area. Where this horizontal line intersects the "per cent of rated capacity" line draw a vertical line upward to the appropriate back pressure line. From this intersection draw a horizontal line to the right to the appropriate "length of pipe" line. Draw a line vertically downward to determine return line size. For more than one trap, work each one through the chart and add areas to get over-all pipe size. The "percent of rated capacity" line is determined by dividing 100 per cent by the factor of safety used.
19. Install a water seal to prevent steam binding when trap can only be installed above lowest point in apparatus. Water seal should be combined with a check valve to prevent back-flow.

Here are some maintenance and trouble shooting suggestions:

1. Check all traps at least once a year for cleaning and possible repair.
2. Check internal parts such as valves, seats, bellows, floats, etc., to be sure they are in good shape.
3. Clean or blow-out strainers at frequent intervals.
4. Certain tools are suggested for checking trap performance:

(a) Thermometers can be placed in thermo-wells before and after traps to check temperatures at these points — indices of performance.

(b) Pressure gage can be placed at inlet of trap to check actual pressure at trap which can in many cases be much lower than boiler pressure. The pressure at the trap inlet (not boiler pressure) determines trap capacity.

(c) A portable contact pyrometer is probably the best tool for checking trap performance, Temperatures on inlet and outlet can be closely esti-

* Application Engineer, Yarnall-Waring Company

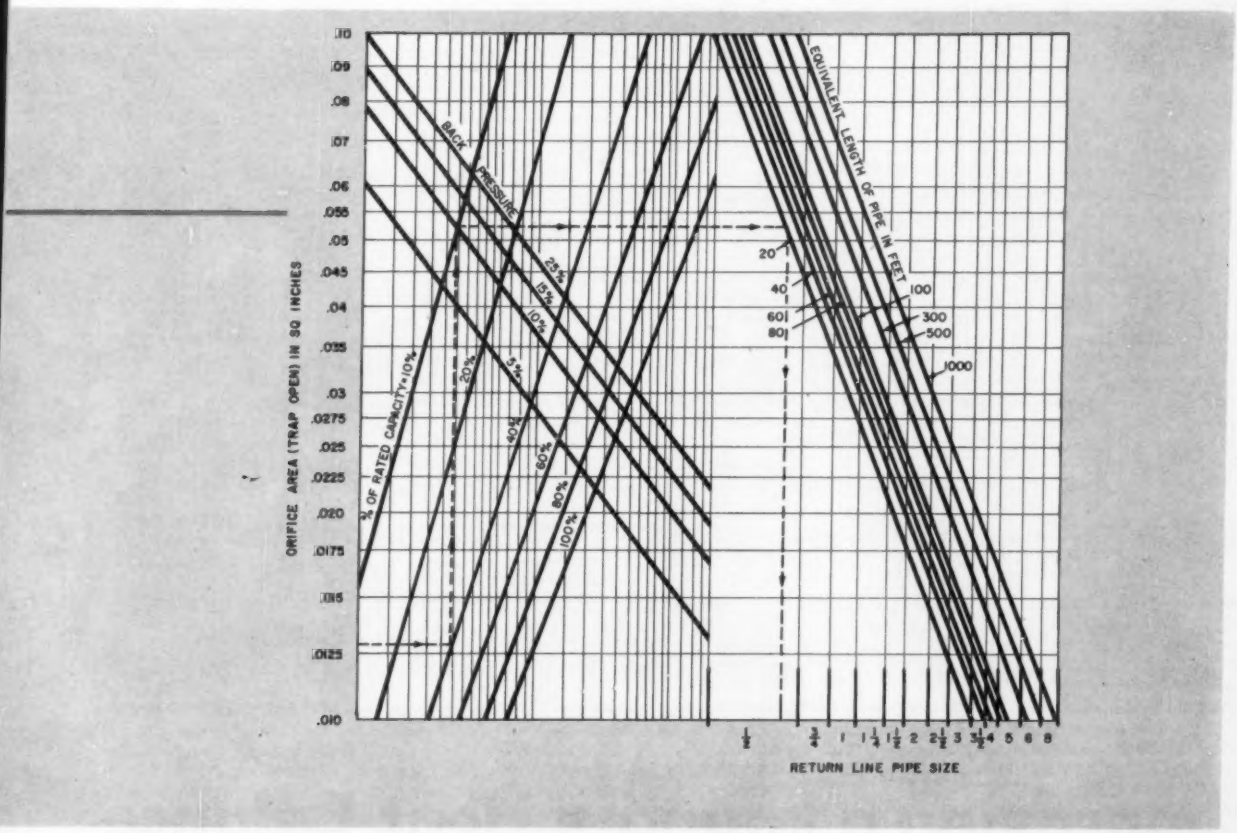


Fig. 3. Chart for finding the return line size. All return lines must be kept large enough to prevent excessive back pressure

mated by use of this instrument in contact with clean metallic surface.

5. A cleaning fluid is recommended for cleaning rust from trap parts.

6. A basic trap hook-up is shown in Fig. No. 1. To check performance of trap C (assuming valve M is open and normal pressure is at trap): —

(a) Close valve F tightly to prevent return line interference.

(b) Open valve E.

(c) If condensate comes out at G, trap is draining.

(d) At this point if equipment N is not up to temperature, the trap may be too small or the strainer B may be partially clogged.

(e) If nothing discharges at G (no pressure) there are three logical possible conditions — inlet valve M is closed or blocked, line or equipment between M and C is blocked, or strainer B is clogged.

(f) If nothing discharges at G with pressure at trap, the trap parts may be worn or defective. If a bucket trap is installed, pressure may be too high, orifice may be too large for the pressure or venthole in bucket may be plugged. If an impulse trap is installed, orifice may be clogged.

(g) If steam discharges at G, there are quite a few possibilities. Trap seat may be worn or wire drawn or held off seat by dirt. Mechanism may be holding valve off the seat. If a bucket trap is installed there is a possibility that there is no condensate in the trap body to float the bucket. In this case close inlet valve to apparatus for a few minutes to reestablish prime. With an impulse trap, the trap may be too large or back pressure too high.

7. If no "T" is available or trap discharges as shown at "D" in Fig. No. 1, a "phantom" test is available by using a contact pyrometer — an instrument used for measuring temperatures of metallic surfaces. By taking a temperature reading on cleaned surfaces at both trap inlet and outlet, trap performance can be analyzed. The inlet temperature should be essentially saturated steam temperature. The outlet temperature should be lower — the degree being partly determined by the type of trap. Impulse traps for example discharge almost continuously very close to steam temperature. On the other hand, bucket traps accumulate condensate which is discharged intermittently resulting in varying outlet temperature. With any trap if inlet and outlet temperatures are *exactly* the same, the trap is blowing steam. Fig. 2 shows a contact pyrometer in use.

8. If a trap drains continuously at constant rate, there is a good possibility that the trap is too small, or apparatus being drained, if heating a liquid, is ruptured and liquid is leaking into the line to the trap.

9. On observing trap discharge do not confuse flash steam with live steam. When the pressure of hot condensate is reduced as it passes through a trap, a certain amount of this condensate flashes into steam at the lower pressure. This is actually a good sign of efficient trap performance. Equipment cannot be kept hot with cold condensate. No flash steam indicates such a condition.

Most traps are small inexpensive devices. If they are properly selected, installed and maintained, they can contribute greatly to overall process efficiency. Much large and expensive equipment can only function efficiently by proper trapping. Thus trap application assumes a much greater importance than is indicated by the relatively small cost of the trap when overall economy of equipment operation throughout a plant is considered.

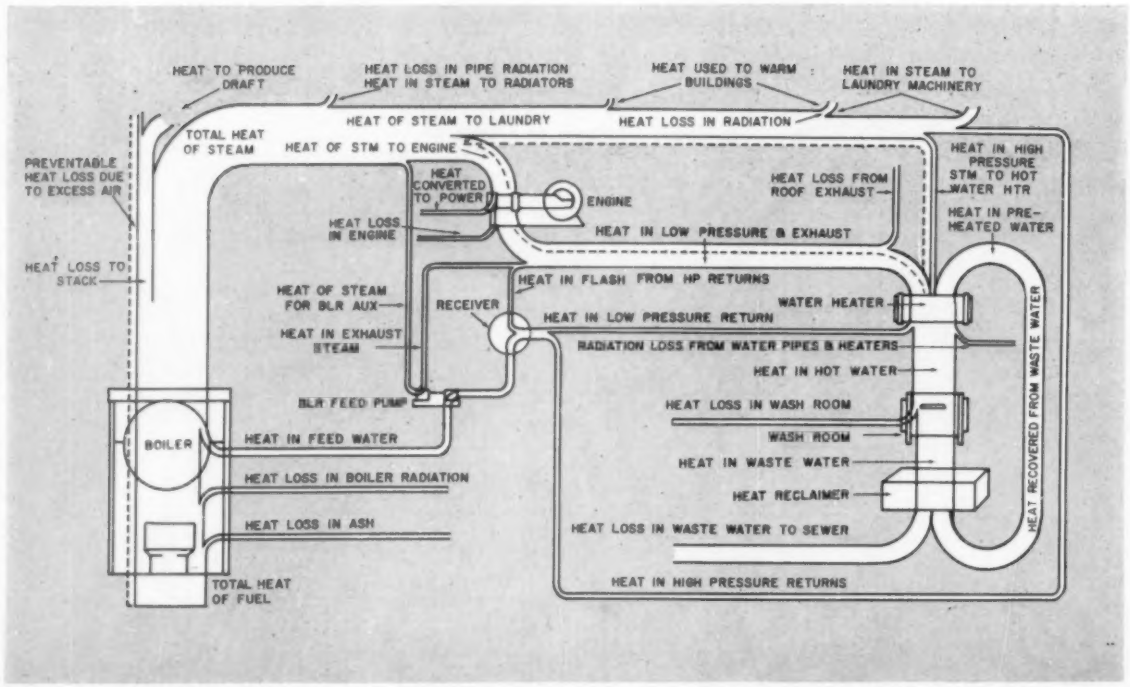

HEAT TO PRODUCE DRAFT
HEAT LOSS IN PIPE RADIATION
HEAT IN STEAM TO RADIATORS
HEAT USED TO WARM BUILDINGS
HEAT IN STEAM TO LAUNDRY MACHINERY
HEAT OF STEAM TO LAUNDRY
HEAT LOSS IN RADIATION
TOTAL HEAT OF STEAM
HEAT OF STM TO ENGINE
PREVENTABLE HEAT LOSS DUE TO EXCESS AIR
HEAT CONVERTED TO POWER
ENGINE
HEAT LOSS FROM ROOF EXHAUST
HEAT IN HIGH PRESSURE STM TO HOT WATER HTR
HEAT IN PRE-HEATED WATER
HEAT LOSS IN ENGINE
HEAT IN LOW PRESSURE & EXHAUST
HEAT LOSS TO STACK
HEAT IN FLASH FROM HP RETURNS
HEAT OF STEAM FOR BLR AUX
RECEIVER
WATER HEATER
HEAT IN LOW PRESSURE RETURN
HEAT IN EXHAUST STEAM
RADIATION LOSS FROM WATER PIPES & HEATERS
HEAT IN HOT WATER
BLR FEED PUMP
HEAT LOSS IN WASH ROOM
BOILER
HEAT IN FEED WATER
WASH ROOM
HEAT IN WASTE WATER
HEAT LOSS IN BOILER RADIATION
HEAT RECLAIMER
HEAT LOSS IN ASH
HEAT LOSS IN WASTE WATER TO SEWER
HEAT RECOVERED FROM WASTE WATER
TOTAL HEAT OF FUEL
HEAT IN HIGH PRESSURE RETURNS

Fig. 1. Typical heat balance for old type of laundry showing many ways in which heat, money, can be wasted or saved

Improving a Laundry Heat Balance

Many old laundries waste money continuously in the form of heat losses. Most of these losses are allowed to continue because they are small; but added together they amount to an appreciable heat loss. Heat balance presented here shows you how money can be saved

IN LAUNDRIES, more than in most plants, small losses here and there throughout the plant soon add up to cause quite a formidable total heat loss. Heat balance can be substantially improved by attending to small leaks and losses throughout the plant, and the heat balance shown here gives a good idea of the many points in a laundry where improvements can be made or losses reduced.

The accompanying diagram visualizes the heat flow between the various units of the laundry. The flow of heat through the plant is shown by a band, the width of which is proportioned to the amount of heat at each particular point. The locations of the various heat losses, together with their relative importance, are indicated.

Initial loss occurs, of course, in combustion. When coal is burned under a boiler, some heat is lost from unburned coal falling into the ashpit. More heat is lost by radiation from the boiler and furnace walls. The greatest loss, however, is the stack loss. Some of the heat that goes up the stack is useful, in that it produces the necessary draft for the fire. With improper combustion or an excess of air, the stack loss will often be as high as 35 per cent of the total heat in the coal burned under the boiler. With the proper firing, the stack loss can be kept at a minimum. In the diagram the preventable loss is indicated by a dotted line.

Steam produced by the boiler is divided into two main parts — the steam for heating the laundry machines and the steam for operating the power unit. Of the heat in the steam going to the various laundry machines, better than half is lost in radiation. In the winter time this radiated heat helps to warm the building, but in the summer months it is not only a loss but an actual discomfort to the operators.

Exhaust steam from the engine is shown on the chart as going to the hot-water heater. In the particular case assumed by the chart, the exhaust steam would be insufficient to supply the amount of hot water required. From the heater the diagram shows the hot water as passing through the wash room and the heat exchanger or reclaimer. Slightly more than half of the heat in the waste water is shown as being recovered and passed on to the hot-water heater in the form of preheated clean water. The balance of the heat in the water is lost to the sewer.

Depending on the capacity of the heat reclaimer, more or less heat can be recovered from the waste water. With an engine developing a given amount of power and exhausting a given quantity of steam, there is no economy in recovering from the waste water any more heat than necessary to produce the required amount of hot water. If a greater amount of heat is recovered than necessary, all the exhaust steam over the necessary amount will be lost through the roof exhaust.

The more economical the engine, the smaller will be the amount of exhaust steam, and a proportionately greater saving can be made by increasing the amount of heat recovered from the waste water. The higher cost of the more economical engine and the larger heat reclaimer must, however, be balanced against the lower cost of a smaller boiler and the saving in fuel brought about by the smaller steam consumption of the engine.

In large finish work plants, where considerable power is required and where ordinarily there would still be

an excess of exhaust steam, even with an engine of the best type, a number of things can be done to reduce the amount of exhaust steam available and make possible the use of a heat reclaimer for recovering and using a large portion of the heat in the waste water.

By increasing the initial or boiler pressure and by reducing the back pressure with the proper design of water heating equipment, the steam consumption of the engine can be greatly reduced. By replacing steam-driven auxiliaries, such as boiler feed pumps, steam-driven air compressors and stokers, with electrically-driven auxiliaries, the exhaust steam which would be obtained from such steam-driven equipment can be reduced. Steam-driven auxiliaries, while simple to operate and extremely reliable, often consume from two to five times as much steam as would be required by the engine designed to accomplish the same result with motor-driven equipment.

In winter excess exhaust steam can be used for heating the building, but this is of little importance. There is always a greater need for steam for heating water in the winter than in the summer. This takes care of any winter excess of exhaust steam, but what is needed is an all-year-round use for exhaust steam.

During such periods as an engine is operating at light load and the demand for hot water is greater than can be supplied by the exhaust steam, the live steam can be used to furnish the necessary heat as indicated by the dotted lines in the diagram.

It will be noted in the diagram that there is a small amount of heat entering the hot-water heater in the form of live steam, while there is at the same time an indication of some exhaust steam being lost through the roof. This is not an unusual condition. Both the supply of exhaust steam and the need for hot water vary, independently of each other, and live steam is usually required to maintain a constant temperature.

Prevention of unnecessary heat loss in the laundry industry requires, in the last analysis, a study of the requirements of each plant. These problems are complicated by seasonable variations in the amount of steam required for heating water; more heat is required in winter than in summer while there is even a variation in the power and hot-water requirements within a single week. Moreover, due to variations in the services offered by laundries, some require more power in proportion to washing than others. The problems of each laundry must be solved on a basis of its particular requirements.

Here Is a New Movie on Cemented Carbides

A NEW 27-minute full color and sound movie has just been completed and is now being distributed on Carmet — Cemented Carbides by Allegheny Ludlum Steel Corp.

The 16-mm movie goes into the manufacture of this important industrial tool and follows the making of Carmet carbides from powder to finished cutting and shaping tools. Applications are shown to give the viewer an insight into the impact these carbide-tipped tools have on the everyday life of industry.

While the movie is semi-technical in nature, it was designed for viewing by high school and college groups as well as the trained and operating machinist and manufacturing personnel.

This movie brings to 19 the motion pictures circulated by Allegheny Ludlum Steel Corp. A copy of Carmet — Cemented Carbides or any of the other movies can be obtained for showing to appropriate groups by writing to the Sales Department, Allegheny Ludlum Steel Corp., 2020 Oliver Building, Pittsburgh 22, Pa.

Data on Second Military Industrial Conference

REAR ADMIRAL Joseph F. Jelley, president of The Society of American Military Engineers, announces that the Second Military Industrial Conference of The Society will be held at the Palmer House, Chicago, February 9 and 10, 1956, under the auspices of the Chicago Post of The Society, and participated in by cooperating agencies of industry, Federal and State Governments, the Armed Forces, engineering and scientific societies, and education.

Theme of the Conference is National Survival in the Nuclear Age. The appalling consequences of nuclear warfare have created a feeling of apathy and frustration in the face of what seems to be the inevitable. The sponsors and cooperating agencies believe that an accurate and understandable presentation of nuclear defense is long overdue. The program of the Conference is to be presented as a contribution to public understanding of the realities of nuclear warfare and the promise of technology in preventing or ameliorating its effects.

Registration fee is $8 per person. For detailed program, data on hotel reservations and full information, write to Military-Industrial Conference Room 1191, 140 S. Dearborn St., Chicago 3, Ill.

Buys Swartwout Power Plant Equipment Div.

THE SWARTWOUT CO. has announced sale of its power plant equipment division to Republic Flow Meters Co. Republic is establishing a Swartwout Division to carry on engineering, manufacture, sales and service of Swartwout's line of steam specialties. These include desuperheaters, regulating valves, feedwater regulators, pump governors, air-operated controls and repair parts.

According to a statement issued by Denton K. Swartwout, president of The Swartwout Co., sale of the power plant equipment division has been under consideration for some time. "We have long felt," said Mr. Swartwout, "that our other divisions — industrial ventilation and autronic process controls — require the full-time efforts of our entire organization. This is particularly true of the autronic division." Expansion of the company's manufacturing facilities for this division are under way.

Changeover from Swartwout to Republic Flow Meters Co. is expected to be completed by March 1. Meantime, orders on hand and current orders are being given prompt attention and no customer inconvenience is anticipated during the changeover.

Other items of Swartwout power plant equipment not involved in the sale are exhaust heads, separators, airfuges, and feedwater heaters. Manufacture of the last three items is to be discontinued as soon as current orders are filled and inventories are depleted. However, repair parts will continue to be available from The Swartwout Co. Production of Swartwout exhaust heads is being continued on an expanded scale with larger inventories to provide immediate shipments.

"Well, yes, if you happen to have a 10-ton crane, it is portable—"

Power Engineering handbook

Water Seals Hot Air Fans

FANS WHICH pick up hot air under pressure and boost the pressure further can expect to have a lot of bearing trouble. When that air is dusty in addition to its heat, the trouble is compounded. This was the case with Detroit Edison's Trenton Channel Station primary air fans. These fans pick up hot air from the forced draft air duct and discharge it into a duct serving the coal pulverizers. Since the suction is under pressure, the hot air escaped along the shaft to blow on the bearing — which failed frequently.

Five different types of shaft seals were tried on these fans, but each proved inadequate. The most effective idea was to blow compressed air on the bearings from an unregulated hose, but the disadvantages of this are obvious. In the first place, bearings still failed (though less frequently), and the compressed air usage was extravagant. Two men from Trenton Channel Station — Ed Embach, assistant operations engineer, and Ken Moody, engineering assistant — devised the *Mood-Em* water seal, which finally solved their problem.

Like most good ideas, the water seal is rather simple. It is similar to those used in the Trenton Channel turbines to seal the vacuum attained on the low-pressure end, but seals against internal rather than external pressure. Essential parts are shown in Figs. 2 and 3. Figure 4 shows the seal installed on the outboard bearing.

The seal consists of a steel disk shrunk onto the shaft so that it will rotate with the shaft inside the seal housing. Water

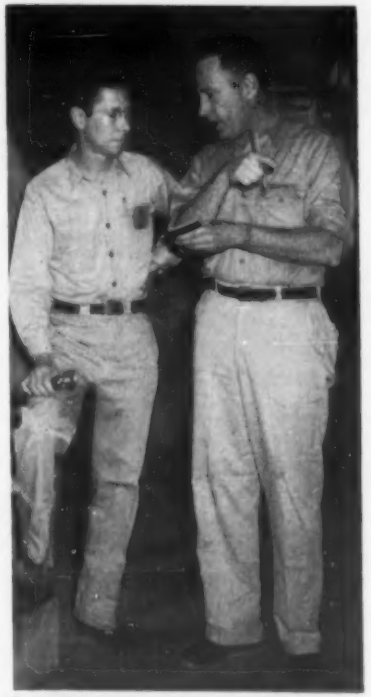


Fig. 1. Trenton Channel men, Ed Embach and Ken Moody, inventors of the Mood-Em water type seal

fold along this line—outside edges toward you

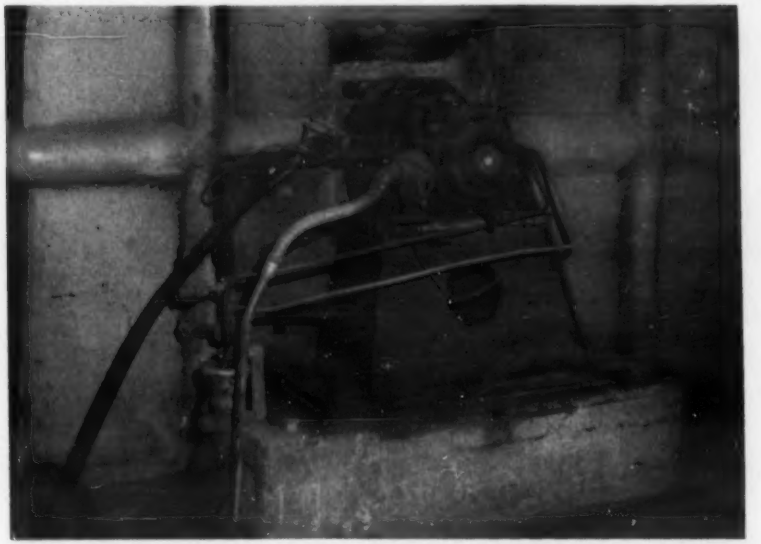


Fig. 2. Before installing the water seals, all the primary air fans were like this. Note cooling air hose

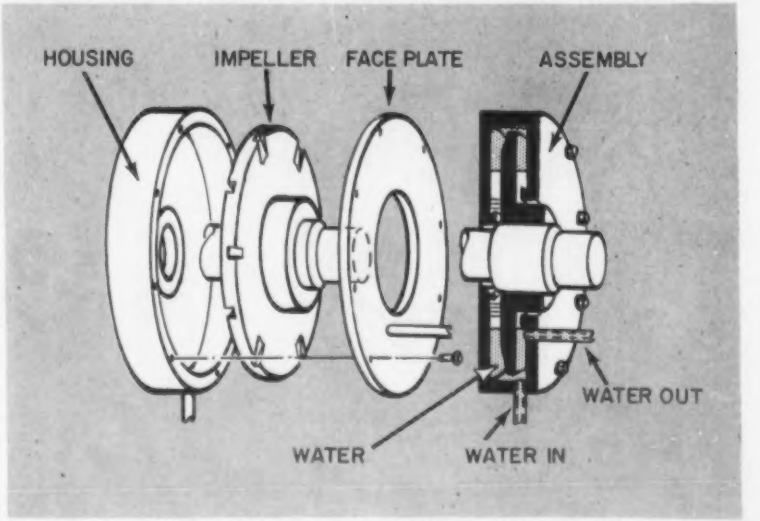


Fig. 3. Details of water-type seal showing extreme simplicity of design and operation (note water ring)

In water conditioning... one grows taller than the rest!

W. H. & L. D. BETZ, Philadelphia, Pa.

is admitted to the bottom of the housing where it is picked up by the rapidly rotating disk. It is then carried around the inside periphery of the housing by the tangential and centrifugal forces so that it forms a ring or doughnut of water (see Fig. 3) inside the housing.

Water not only forms the seal against air leakage, it cools the shaft by removing heat from the shrunk-on disk, and this maintains a lower bearing temperature. The water ring in the seal is not static, but is constantly replenished from below and is constantly discharged through a levelling scoop on the side of the housing. This provision maintains a constant water level in the seal and keeps the temperature of the water low. The fact that heat transfer surfaces are rather small is not critical since the speed of the disk rotating through the water ensures a good heat transfer rate.

Disk speed and diameter and the density of water (not considered variable) all figure in the amount of pressure the water seal can stop. The location of the levelling scoop on the side of the housing will also affect the sealing potential. A water seal acts must like a simple U-tube partially filled with water; the deflection of the water column in the U-tube corresponds to the pressure differential between the two legs, and is similar to the difference in water level on opposite sides of the rotating disk in the seal.

When the air pressure on the fan side of the seal increases, the water on that side of the disk will be forced outward, around the edges of the disk, and into the low-pressure side of the disk. Since the levelling scoop limits the amount of water that can be transferred to the low-pressure side of the disk, it would seem that the sealing ability of the unit would be quite limited. However, the principal force opposing the fan pressure is the centrifugal force differential caused by the different quantities of water being rotated at the same speed on opposite sides of the disk. The pressure displacement of water to the low-pressure side will be only a fraction of the static displacement necessary for the same pressure differential. As rotational speed goes up, the displacement corresponding to a given pressure differential drops.

Since some doubt existed within the company as to the seal's ability to "hold its water" against the pressures involved, Moody and Embach decided to build a 6-in. model with plastic sides to show the water path and levels. This unit was capable of sealing up to 14 in. of water pressure without spilling water along the shaft. Since this was well above the pressures at the fan intake, it was decided to build a full-scale (12-in. diameter) unit for trials on one of the primary air fans. This unit sealed properly, but the housing construction (in halves) permitted water leakage which was hard to control.

A new model with the housing in one piece was made and reinstalled. This one did not leak — either air or water — but a ring of rust built up inside the water doughnut in the air space. Another model, cadmium plated, replaced the second and operated successfully. It is not likely, however, that the cadmium plating will stand up long under continuous duty, so 16 units being made up for the other fans will be fabricated of stainless steel or bronze.

It seems likely that these compact seals will find wide application in the near future in pneumatic conveying systems as well as in the duty for which they were originally designed. They promise increased reliability, greater cleanliness, and lower maintenance costs.

IDEAS ARE WORTH MONEY

MOST PLANT OPERATORS dream up ingenious ways to lighten their work or improve the machines in their charge. It is good sense to share these ideas with other operators and engineers. By sharing through these pages, benefits are both immediate and long-range. You will be paid for your ideas by the POWER ENGINEERING Handbook, and you will be improving your industry. Ideas should be clearly described and illustrated, but ink drawings are unnecessary.

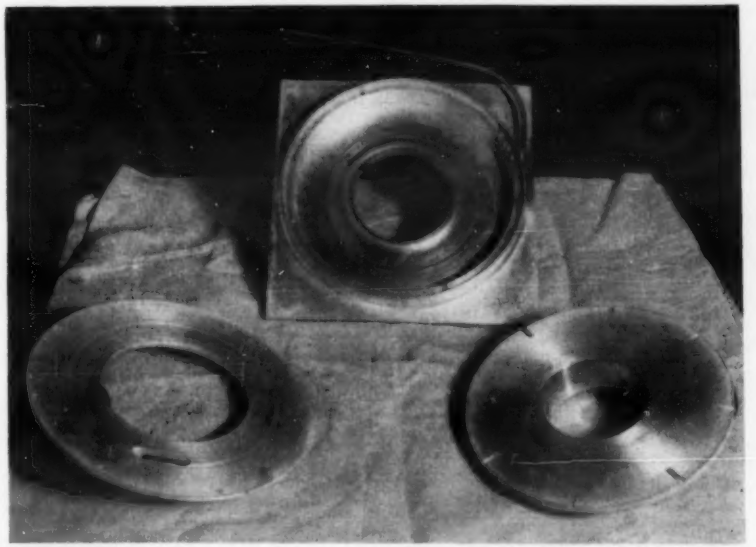


Fig. 4. All parts of the cadmium-plated seal are shown here; l to r: face plate, housing, and impeller

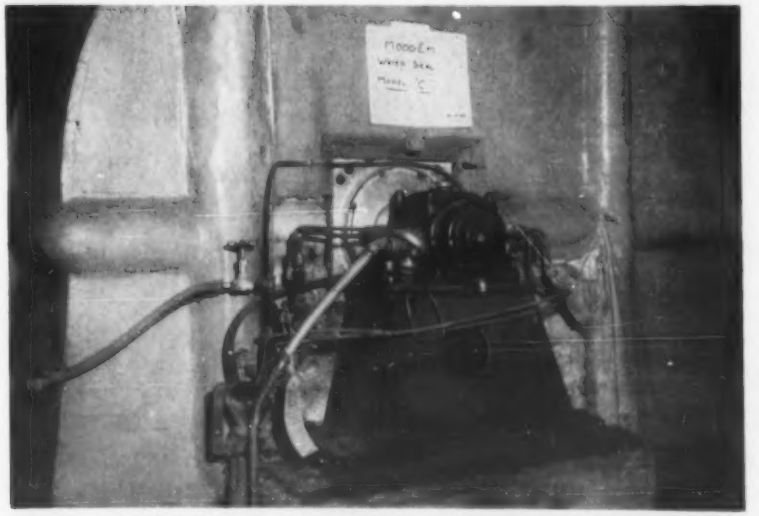
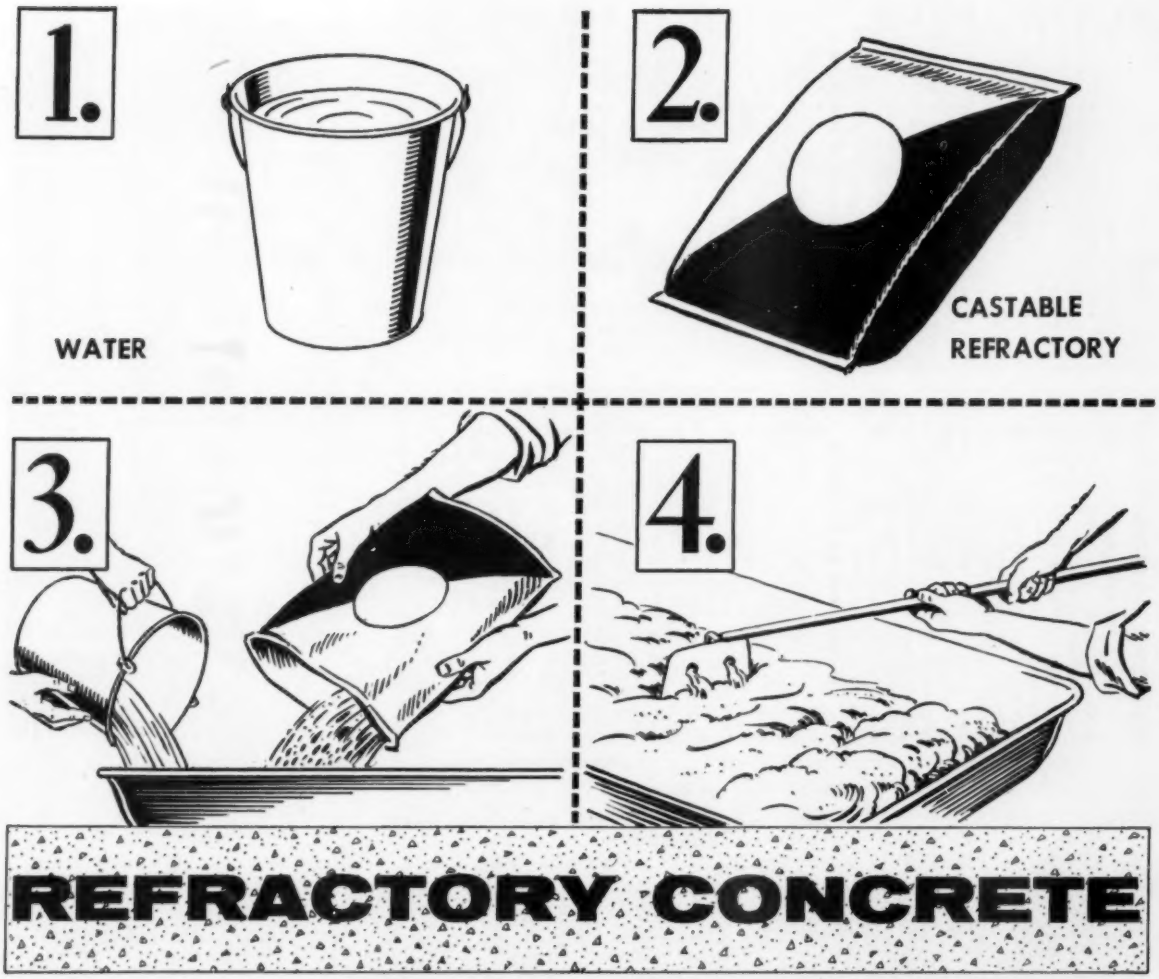


Fig. 5. Compactness of seal is shown by this early model on test at Trenton Channel, No. 17 primary fan



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Power Engineering handbook

Let's Talk Combustion

Part I

By R. R. TAGGS

COMBUSTION is a very complex subject about which many complete books have been written. The term *combustion guides* encompasses many types of instruments and their applications. Consequently, any condensed treatment of these two subjects must touch only on some of the fundamental factors involved and the general trends in power plant or industry.

Basically, good combustion involves the proper combination of fuel and air, temperature, turbulence, and time. In most fuels, the principal elements will be carbon and hydrogen, although some will contain small amounts of sulphur, while others, such as blast furnace and producer gas, will include relatively high percentages of CO. This article will devote attention primarily to the oxidation of hydrogen and carbon.

Essentials of Good Combustion

In the burning of any fuel, the main objective is to utilize all available combustible without losing valuable Btu up the stack or into the ash pit. Enough oxygen must be supplied to consume all of the fuel element; however, any excess oxygen and nitrogen that appears in the combustion gases must be heated, and since heat contained in gases leaving the boiler setting is lost, air supply should be held to a practical minimum. Furthermore, increasing the volume of gases also increases the velocity with which they pass through the furnace and boiler. As heat transfer depends partially upon the length of time that gases are in contact with heat-absorbing surfaces, increased velocity reduces heat transfer and creates higher gas temperatures.

There is considerable difference between practical and theoretical fuel-air ratios, and actual requirements will depend on the fuel, the furnace size and shape, the ash-softening temperature, the method of ash disposal and other factors of steam generator and fuel-burning equipment design. In some cases, where coal and gas are burned in the same furnace, it may even be necessary to consider superheat temperature in arriving at the proper fuel-air ratio. Some excess air will always be required, and after the practical ratio for best over-all performance has been determined, considering combustion efficiency, maintenance and steam production, efforts can be directed towards maintaining proper conditions.

Theoretical Air Requirements

As previously mentioned, carbon is one of the two main elements in fuels. When burning pure carbon, one molecule of carbon combines with one molecule (two atoms) of oxygen to produce one molecule of CO_2. Since air consists of 20.9 per cent oxygen, and 79.1 per cent nitrogen by volume, each molecule of oxygen is accompanied by 3.78 molecules of nitrogen, which passes through the boiler without any change. Therefore, the combustion gases contain one molecule of CO_2 and 3.78 molecules of nitrogen, which means CO_2 constitutes 20.9 per cent of the total volume.

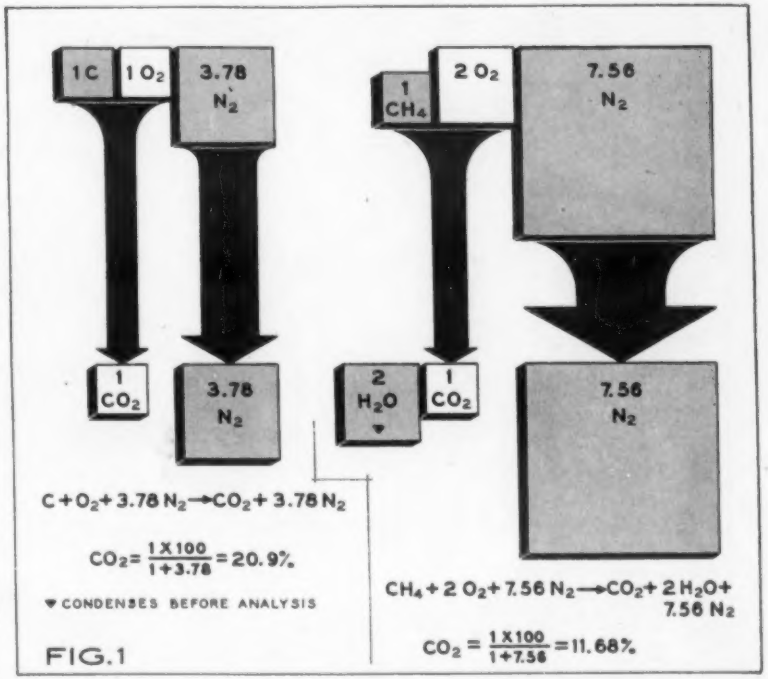


FIG. 1

This, of course, corresponds to the percentage of oxygen in air and is correct as all oxygen in the air has combined with carbon. Adding carbon to oxygen does not change the volume of the gas but does change its weight. A molecule of CO_2 has the same volume as a molecule of oxygen but is heavier.

Carbon is at one end of the fuel scale with various forms of coke and anthracite coal approaching this limit although all contain *some* hydrogen. At the other end of the range normally encountered in industry is methane, or CH_4, one of the main constituents of natural gas. Burning methane involves combining the carbon with oxygen to form CO_2 and the hydrogen with oxygen to form H_2O (water). One molecule of methane, two molecules of oxygen, and 7.56 molecules of nitrogen produce one molecule of CO_2, two molecules of water and 7.56 molecules of nitrogen.

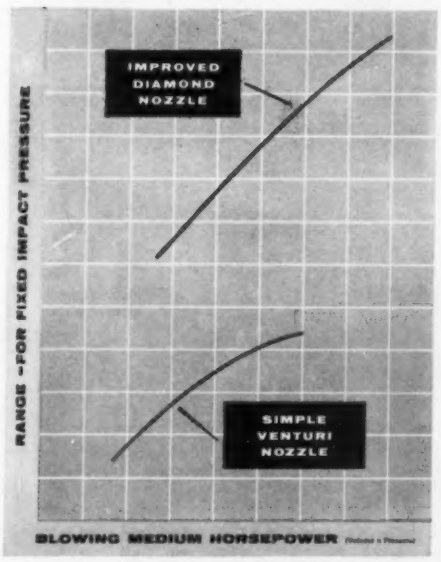
In order to reduce gas measurement to some standard base, it is common practice to consider all flue gas analyses on a dry basis and all water vapor is removed or cancelled out. Consequently, when burning methane CO_2 will be 11.68 per cent of the total volume of combustion gases with water removed. The equations representing these two extreme theoretical conditions are shown in Fig. 1. Most common fuels will fall within these two limits, and the percentage of CO_2 between 11.68 and 20.9 will depend on the hydrogen-carbon ratio.

The term hydrogen-carbon ratio is used to indicate the relationship between the hydrogen and carbon content of the fuel. It represents the ratio of hydrogen by weight to carbon by weight. Consequently, the hydrogen-carbon ratio for pure carbon is zero and that of methane is 0.333.

GETTING BACK TO FUNDAMENTALS:

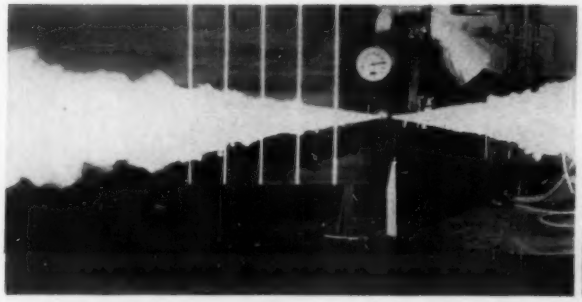
Efficient BOILER CLEANING Starts at the BLOWER NOZZLE

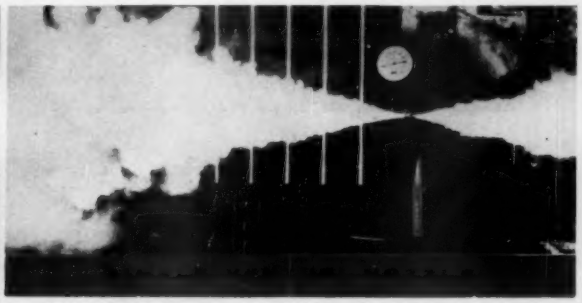
Photograph of section through Diamond "Type A" Nozzle.



The blower nozzle has the job of converting steam or air pressure into velocity which, in turn, produces impact pressure at the surface to be cleaned. Effective cleaning depends on this impact pressure. A well-designed nozzle will convert much more efficiently . . . doing a better cleaning job with less steam or air.

During the past several years Diamond has conducted intensive research into nozzle design to find the ultimate in efficiency. (More than 50 designs were tested.) It was soon found that nozzle design responds to perfection of detail. Among the details studied were: (1) divergence angle of nozzle, (2) inlet radius as a function of throat diameter, (3) length-diameter ratio of nozzle, (4) area ratio of lance to nozzle throat, and (5) nozzle approach conditions. A product of this research is our new "Type A" Nozzle for Model IK Blowers. The curves at the left show how much more efficient it is than the simple venturi nozzle. The result is improved cleaning at substantially lower energy cost.





The two photographs above show the Improved Diamond Nozzle and the simple venturi nozzle under identical test conditions. These tests proved that the effective range of the new Diamond nozzle is substantially greater. Also that at the same range, the impact pressure of the Improved Diamond Nozzle is much higher than for the simple nozzle. For equal cleaning ability, the higher efficiency of the new Diamond nozzle requires a much lower blowing medium pressure.

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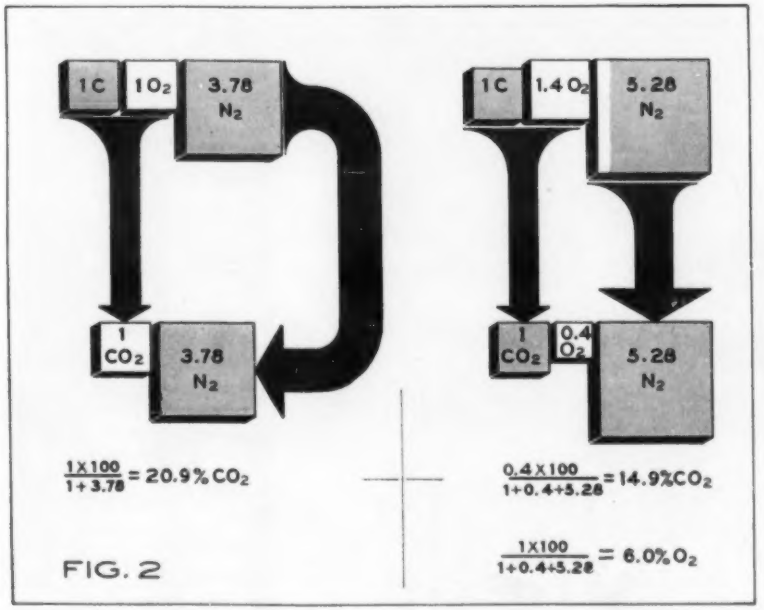


FIG. 2

In Fig. 2, the values shown on the left are the purely theoretical calculations previously mentioned, and do not take into account the fact that excess oxygen or excess air will be required to insure complete combustion. If 40 per cent oxygen or air was used during the burning of carbon, the oxygen and nitrogen percentages would be increased by 40 per cent. Since only the same amount of oxygen is utilized for burning the fuel, 0.4 of a molecule of oxygen and approximately 5.28 molecules of nitrogen would appear in the combustion gases. Under these conditions, CO_2 content will be reduced to 14.9 per cent but a new element, excess oxygen as approximately 6.0 per cent O_2 will also appear in the gases.

If there is a deficiency of oxygen, all of the carbon does not oxydize to CO_2 and some CO occurs in the exit gases. Presence of any CO represents a real loss as one lb of carbon burning to CO yields only 4350 Btu, whereas one lb of carbon burning to CO_2 yields 14,550 Btu. Thus the second atom of oxygen produces a much greater heat release than the first, and insufficient oxygen causes a substantial heat loss.

Figure 3 shows the relationship between oxygen, excess air, CO_2 and hydrogen-carbon ratio for various fuels. The short diagonal line in the left-center, calibrated from zero to 0.33, is marked in terms of hydrogen-carbon ratio. As previously mentioned, carbon possesses a zero ratio and methane a ratio of 0.333 with most of the other conventional fuels falling between these two points. Some bituminous coals will fall at about 0.07 on the scale, while some fuel oils will have an approximate 0.11 hydrogen-carbon ratio.

If hydrogen and carbon are essentially the only two combustibles present and the hydrogen-carbon ratio of the fuel is known, the percentage of CO_2 and O_2 can be determined for any percentage of excess air. For a fuel having a hydrogen-carbon ratio of approximately 0.07 with 40 per cent excess air, drawing a line through the proper points on the respective scales gives 12.7 per cent CO_2 and 6.2 per cent O_2. It would, of course, also be possible to determine the approximate hydrogen-carbon ratio of a fuel and the percentage of excess air if the percentage of CO_2 and O_2 were known and no combustibles were present.

Although CO_2 will vary widely, O_2 will remain very nearly the same for any given amount of excess air regardless of the variation in hydrogen-carbon ratio. For example, with 30 per cent excess air, the oxygen content is approximately 5 for bituminous coal and 5.25 for methane while CO_2 content varies from 8.8 to 13.7. This relationship is significant when several fuels of different hydrogen-carbon ratios are burned.

Orsats

In establishing the fuel-air ratio to be maintained, measurements of oxygen, CO_2, and CO are desirable to determine the amount of excess air and to prove that combustible in the form of CO is not being lost. The conventional three-chamber hand orsat normally employed to test gas samples appears to be most popular at this time. This instrument has three pipettes or chemical chambers in which CO_2, O_2, and CO are absorbed and the resulting change in volume measured. From this information, both operating procedure and fuel-air ratio can be established. Orsats also provide a means of checking other combustion guides in the plant and furnish data necessary for calibrating instruments such as the air flow-steam flow meter.

Types of Combustion Guides

In addition to this test instrument, most plants use an instrument to provide a continuous record of combustion efficiency. Such an instrument is valuable not only because of the record itself but also because it shows both the direction and rate at which any change is occurring, and enables the operator to make adjustments of the proper magnitude. There are two general types of recording combustion guides available: qualitative and quantitative. Flue gas analyzers such as CO_2 and O_2 recorders are of the qualitative type as they actually measure percentages of gases present rather than quantities. Air flow-steam flow, or gas flow-air flow meters are of the quantitative type since they measure the total flows involved. Each type of instrument has a definite place in the combustion field.

Air Flow-Steam Flow Meters

Next month, air flow-steam flow meters will be discussed. Their theory of operation and applications in the boiler plant will be explained. Also coming up, *Measuring Air Flow*, *CO_2 Recorders*, *Multiple Fuel Firing*, *O_2 Recorders*, and a summary on combustion practice.

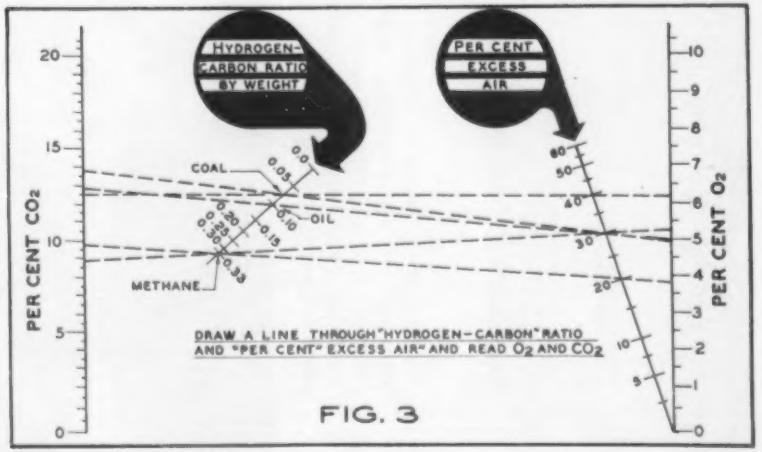
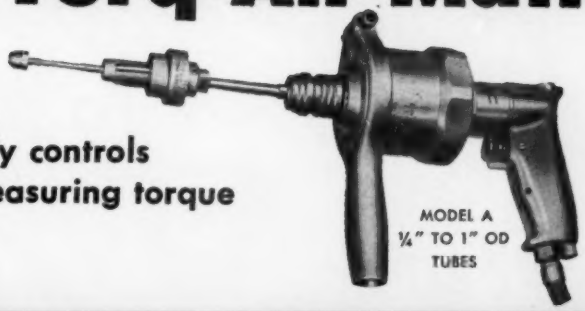


FIG. 3

fold along this line—outside edges toward you

New WILSON Torq-Air-Matic

First and only air-driven tube expander drive that accurately controls tube expansion by directly measuring torque output at the mandrel.



MODEL A
¼" TO 1" OD
TUBES

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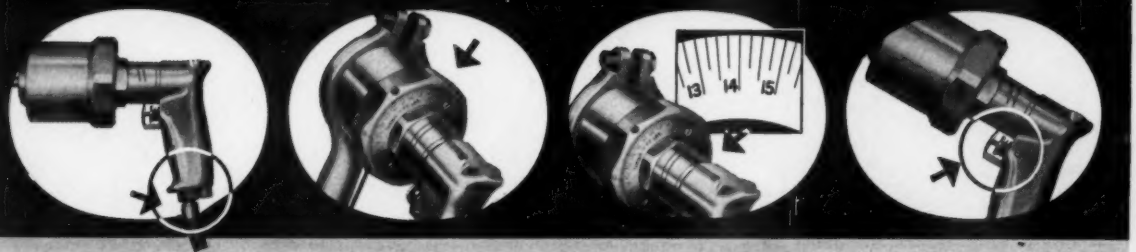

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CALIBRATION—The only tube expander control calibrated *in terms of foot pounds torque instead of meaningless arbitrary units.* Torque requirements for expanding tubes of off-standard jobs can be more readily arrived at.

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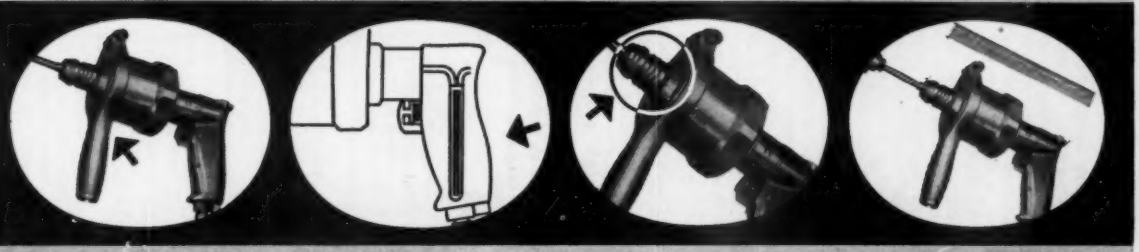

CONVENIENT—*Furnished with an auxiliary handle that can be swivelled to any position desired* by the operator or left off when the torque reaction is not too great. Basic unit is of a pistol grip design.

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CHUCK—*Simple, new type, snap on floating chuck. Only one motion* instantly engages or disengages a square shank mandrel—no set screws.

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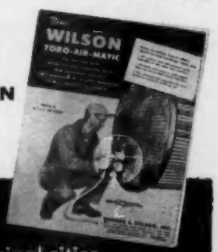

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Power Engineering handbook

Boiler Water Chemical Treatment

By CHARLES B. SCHARP *

DURING the past several years much has been written concerning the internal chemical treatment of water serving boilers of both utilities and industries. In addition, several interested organizations have formed committees whose purpose is to further the art of power plant chemistry. With the introduction of high pressure, high temperature boilers, particularly in the utility field, a reevaluation of feed water and boiler water treatment was undertaken with the subsequent publication of numerous articles. The vast array of publications in this field concern themselves with the benefits of a particular chemical or system of chemicals to which there is usually some disagreement among power plant chemists. It is the purpose of this paper to review the field of internal water treatment by chemicals and to examine various chemicals which have been or are being used.

Cause and Prevention of Scale

The heating and concentration of boiler water causes the precipitation of a number of compounds which decrease in solubility as the temperature is raised, such as calcium sulfate, silicate, and carbonate, and magnesium hydroxide and silicate. The internal chemical softening of boiler water prevents the formation of scale by precipitating calcium and magnesium in the form of sludge. This scale prevention is accomplished by addition of either phosphates, soda ash, sodium aluminate, alginates or sodium silicate.

Soda ash and *caustic soda* were used originally to cause calcium to precipitate in carbonate form by the use of a carbonate to sulfate ratio. These ratios were later found to be extremely high causing softer scales of a greater amount since some calcium sulfate was precipitated also. In addition, soda ash produces carbon dioxide which can cause corrosion when dissolved in water.

Phosphates have supplemented carbonates as a specific precipitant for calcium. Phosphates remove calcium so completely that calcium sulfate and silicate scales may be entirely prevented. The precipitates resulting from the addition of phosphates are tricalcium phosphate and magnesium phosphate in low pressure boilers. Hydroxy apatite, $Ca_{10}(OH)_2(PO_4)_6$, is the usual precipitate above about 50 psi and a pH of 10.0. The criterion for the selection of the best phosphate chemical is the alkalinity added to the boiler water, its solubility and ease of handling. Monosodium phosphate is acid; sodium hexametaphosphate is neutral in cold water but will attack chemical pumps, tanks and piping as temperatures increase; disodium phosphate is mildly alkaline; and trisodium phosphate is strongly alkaline. Phosphate treatment is based upon the concentration of soluble phosphate ion, PO_4, in the boiler water. With low make-up, this may be maintained safely at 20–40 ppm.

Sodium aluminate and *silicate* may form complex silicate scales which are not preventable under conditions of high temperatures and rates of evaporation in the presence of aluminum and iron compounds. Sodium silicates decrease in solubility and may form deposits above 250 psi at points of boiler water concentration whereas potassium silicates do not exhibit this tendency.

Sodium alginates coat calcium and magnesium precipitates to prevent agglomeration and have some of the dispersive properties of other organic chemicals. Alginates are usually marketed as ingredients of formulated boiler compounds.

Disodium phosphate is used for scale prevention in most high pressure boiler installations for three important reasons: (1) To precipitate calcium in a form that won't stick, (2) to have no effect upon the hydroxide alkalinity, making control easier than other forms of phosphate, and (3) to aid in the detection of calcium leakage into the system by mixing disodium phosphate and caustic soda in such a ratio that hydroxide alkalinity is 125 to 170 ppm and phosphate is 20 to 40 ppm.

Cause and Prevention of Corrosion

Corrosion in boilers can be attributed directly to low pH of the boiler water, the presence of dissolved oxygen in the boiler feed water, or the presence of scale, dirt or low alkalinity in the boiler water. Control of pH is accomplished by addition of caustic soda, soda ash or sulfuric acid and by recirculation of boiler water.

In high pressure boiler operation experience has shown that it is desirable to maintain a minimum boiler water pH of approximately 10.5. This pH value is sufficiently high to prevent acidic attack on the boiler metal and also provides sufficient alkalinity for the precipitation of scale forming salts by the previously described treatment. Boiler water pH and alkalinity are usually increased by the addition of *caustic soda* solution to the boiler drum. *Soda ash* should not be used to raise the pH of the feed water or boiler water because it decomposes in the boiler to produce carbon dioxide, making the condensate more corrosive. If the make-up is softened by the hot lime-soda or phosphate processes, no caustic feed is necessary and, if the percentage of make-up is high enough to cause formation of carbonate sludge or phosphate scale in the economizer and high stage heaters, reduction of feed water pH may be necessary by addition of *sulfuric, sulfurous,* or *phosphoric acids.*

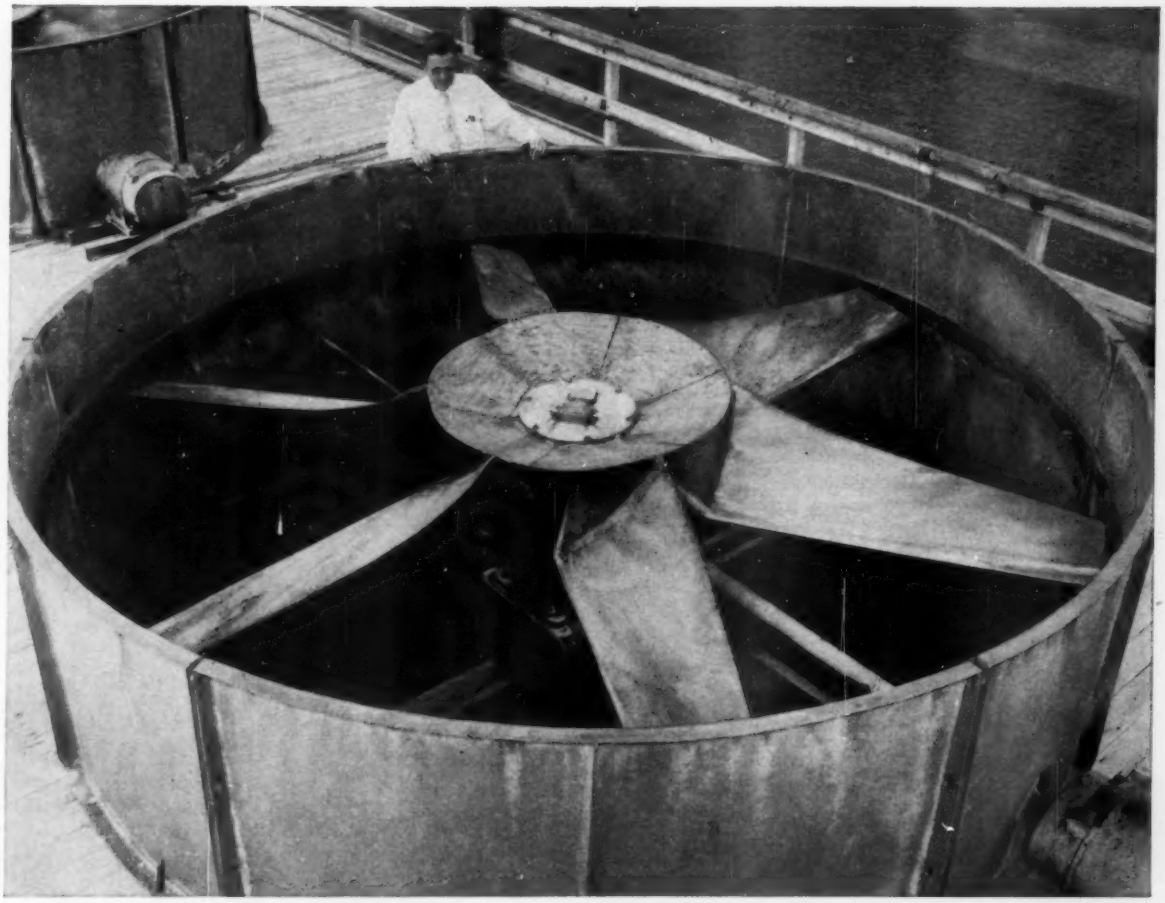
Feed water pH can be raised by continuous boiler water recirculation; i.e., drawing off a controlled quantity of boiler water and returning it to the boiler feed line. The resulting increase in feed water pH reduces the likelihood of corrosion without the use of additional treatment and without increasing the solids content of the system. Since iron is least soluble in distilled water at a pH of 9.6, the increased pH of the feed water protects the feed pump, feed line and economizer from corrosion. Control of the quantity of boiler water recirculation is through adjustment of the flow control valve by analysis of feed water mixture for pH and phenolphthalein alkalinity.

Dissolved oxygen can be introduced into boiler systems with make-up water and through infiltration into the vacuum portions of the condensate system. It usually causes pitting corrosion when released within the boiler. The first step in eliminating dissolved oxygen is mechanical deaeration of the boiler feed water. This will reduce the dissolved oxygen content to very low values and should be followed by chemical deaeration to remove the last traces of dissolved oxygen. Chemical deaeration is accomplished by addition of sulfite, tannins, glucose derivatives or hydrazine.

Sodium sulfite is the agent favored for chemical deaeration due to its low cost, ease in handling and lack of scale forming characteristics. However, recent experiences have shown that it is desirable to limit the sulfite in high pressure boilers to as low a concentration as is consistent with complete removal of oxygen to avoid corrosion in condensate lines due to acidic products caused by the breakdown of sulfite in the boiler.

Hydrazine has shown some promise in recent years as a deaerating agent and in its reaction with dissolved oxygen, water is formed and nitrogen gas is released. These products are harmless and do not increase the total solids content of the boiler water. However, hydrazine is more expensive than sodium sulfite and produces handling problems due to its explosive characteristic and noxious effect upon those who contact it in dilute solutions. In addition, recent studies have shown that the degree of reaction between hydrazine and dissolved oxygen depends upon the amount of iron and

* Assistant Engineer, Power Production Stations, Baltimore Gas and Electric Company, Baltimore, Maryland, Associate Member, A.S.M.E., P.E.



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copper present in dissolved form in the water. Since these two elements are the result of corrosion, their presence is undesirable.

Tannins, Lignins and *glucose derivatives* do not remove oxygen by absorption but form a protective coating on the boiler metal and condition the sludge. The usefulness of tannins is limited to pressures below about 300 psia due to their unstable properties at high temperatures. Tannins also produce a brown color in the boiler water which interferes with certain analyses. Lignins are usually stable up to 650 F but some have shown evidence of decomposition at lower temperatures.

In high pressure boiler installations corrosion control in the boiler water and feed water usually is accomplished by one or more of the following methods: (1) Use of *caustic soda* to increase the boiler water pH and alkalinity. pH is maintained between 10.5 and 11.3 in the boiler, (2) recirculation of a part of the boiler water to increase the pH of the feed water. Boiler water is usually recirculated to the storage tank of the deaerating heater to raise the pH of the feed water to about 9.0. This procedure allows the removal of oxygen and carbon dioxide gases by mechanical deaeration before the introduction of chemicals into the recirculated boiler water, and (3) use of *sodium sulfite*, pumped to feed water, to maintain constant sulfite residuals in boiler water.

Corrosion by Condensate

The primary causes for steam and condensate return line corrosion are the dissolved gases: carbon dioxide, oxygen, sulfur dioxide and hydrogen sulfide. Iron reacts with dissolved oxygen to form ferric hydroxide which can revert to iron oxide rust. When carbon dioxide dissolves in water it forms carbonic acid which is a weak acid and produces ferrous oxide, iron oxide, magnetite, ferrous bicarbonate, etc. These iron deposits are usually responsible for plugging. The chief source of carbon dioxide is the bicarbonate and carbonate alkalinity of the make-up water to the boiler. The prevention of this type corrosion is accomplished by the addition of alkalies, polyphosphates, ammonia, neutralizing or filming amines.

Alkalis in a water solution are fed to the steam in order to increase the pH of the condensate through reaction with carbon dioxide. *Polyphosphates* have been employed to a minor extent in a similar manner in the hope of forming an iron-phosphate film on the metal surfaces. Neither of these methods has been very successful in treating carbon dioxide corrosion and both are objectionable for the same reason that carry-over of boiler solids is undesirable.

Ammonia, in the form of ammonia hydroxide or ammonia sulfate, has been successfully used where low make-up water is needed and there is low carbon dioxide concentration in the steam. However, the quantity of ammonia needed in the liquid to produce a pH of 9.0 will necessitate seven to ten times the quantity in the steam. This quantity of ammonia in the steam will cause corrosion in the condenser and steam jet air pump unless oxygen leakage into the system is eliminated.

Neutralization of carbonic acid can safely be accomplished by certain volatile amines, such as *morpholine* or *cyclohexylamine*, which volatize with the steam and combine with the carbon dioxide in the condensate to neutralize its acidity. The neutralizing amines do not protect against oxygen attack except by keeping the metal clean and preventing solution of the metal and are relatively high in cost where high concentrations of carbon dioxide are present. The quantity of cyclohexylamine needed in the liquid to produce a pH of 9.0 necessitates two to four times the quantity in the steam which can dissolve brass without oxygen present, if there is a concentration of cyclohexylamine in a meniscus, such as on tube sheets of the condenser. The distribution ratio of morpholine is such that only a small amount is in the steam which minimizes vapor losses of the amine. Morpholine is not a solvent for copper or brass. However, a small amount of morpholine may decompose to form ammonia, which can cause corrosion in the condenser if the pH is over 10.0.

The *filming amines* prevent corrosion by deposition of a film on the metal surfaces. They do not neutralize carbon dioxide but form an impervious, nonwettable film that acts as a barrier to both oxygen and carbon dioxide attack. The amine will penetrate corrosion products present and the film does not increase with continuous treatment. The most useful amines of this type are *octadecylamine, hexadecylamine,* and *dioctadecylamine*. These amines are fed from a water solution to the steam at a point where they will be well mixed with the steam. The filming amines are usually more expensive than the neutralizing amines except where high concentrations of carbon dioxide are present. The filming amines are primarily applicable to pressures below about 200 psig. At higher pressures these organic amines tend to break down, which can deposit hydrocarbon tars over the metallic surfaces. The point at which the filming amines become more economical than the neutralizing amines is a carbon dioxide concentration of about 8 ppm. A secondary benefit derived from the filming amines is their ability to promote dropwise condensation of the steam which could provide more efficient heat transfer than film condensation. However, the amine film usually has a low heat transfer coefficient. There is no published information available as to the magnitude of this amine film coefficient, which makes a cost estimate involving the heat transfer have little meaning. Therefore, costwise, one must be guided by the carbon dioxide concentration, which in most high pressure boiler installations is less than 1 ppm and favors the use of the neutralizing amines.

Intercrystalline Cracking of Boiler Metal

There are three factors necessary to produce intercrystalline cracking of boiler metal, (1) leakage of boiler water and concentration of sodium hydroxide at point of leakage, (2) boiler metal subject to a high stress, and (3) possession by boiler water of embrittling characteristics. Early work in the field of caustic metal embrittlement indicated that sodium sulfate possessed the ability to render a boiler water non-embrittling. The ASME sulfate-carbonate ratios were established but later work has shown that these ratios did not necessarily protect against embrittlement. The study of the embrittling characteristic of boiler water is conducted through the use of an embrittlement detector. These studies have indicated that the presence of phosphates, tannates, or nitrates will inhibit the embrittlement by caustic soda if they are present in the proper proportions.

The simultaneous control of pH and phosphate content of a boiler water such that the pH value of the boiler water is always lower than the pH value of a trisodium phosphate solution of the same PO_4 content is one method of embrittlement control. In using this treatment calcium and magnesium scales are prevented by keeping calcium and magnesium out of the system by external water treatment. Trisodium phosphate will neither cause nor prevent intercrystalline cracking, but when leakage occurs and concentration of boiler water develops, the solid material deposited at the point of concentration will be trisodium phosphate and not sodium hydroxide. When the boiler water contains bicarbonate and carbonate alkalinity, disodium phosphate, monosodium phosphate or phosphoric acid will be required to obtain the proper pH-phosphate relationship due to the formation of sodium hydroxide. This method of caustic embrittlement control provides a simple solution since no new ions are introduced and the solids are maintained at a minimum.

In some systems *sodium nitrate* can be used in a definite ratio with sodium hydroxide, depending upon the operating pressure. Sodium nitrate is usually fed continuously to the boiler feed water or boiler drum. This method has been quite successful in stationary boilers at pressures as high as 900 psi. The nitrate nitrate content of boiler water can be determined by a simple, rapid test.

Tannates can be used in boilers up to about 700 psi pressure for the control of intercrystalline cracking by maintaining a definite tannin-sodium hydroxide ratio. The use of tannins has the disadvantage of highly coloring the boiler water.

In most high pressure boiler installations, no specific treatment is prescribed for the prevention of intercrystalline cracking of boiler metal but advantage is taken of the welded construction of the boiler and other treatments listed above.

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FIG. 11365—Steel Pressure Seal Horizontal Lift Check Valve For 1500 Pounds W.S.P.

FIG. 11323—1500-Pound Motor Operated Steel Pressure Seal Gate Valve.

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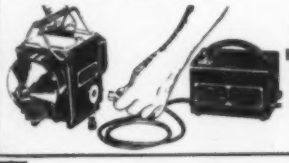

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OBITUARIES

Joseph L. Comer

JOSEPH L. COMER, vice president of the Wm. Powell Co., died December 31 in New York City following a brief illness. Mr. Comer, age 61, had been general manager of Powell's New York office since October 15, 1948. He had held executive positions in the industry prior to that.

Marshall L. Hough

MARSHALL L. HOUGH, 56, president of Darling Valve & Manufacturing Co. of Williamsport, Penna., suffered a cerebral hemorrhage while at work on December 7 and died later that day at the Williamsport Hospital. He was president and treasurer of Darling Valve for the past 20 years and a member of the Valve Manufacturers Association. He was particularly active in American Red Cross work, served for almost 25 years as a director of the Lycoming County Chapter and became chairman of the chapter in 1944.

Mr. Hough completed his schooling at Cornell University Engineering School, returned to Williamsport in 1921 and went to work in the drafting department of Darling Valve. In 1930 he was elected Vice President and Treasurer and he became President in 1936.

Frank Edward Payne

FRANK EDWARD PAYNE, chairman of the board and co-founder of Crane Packing Co., died November 20 at his home in Glencoe, Ill. The 72-year-old industrialist had been ill for a long time.

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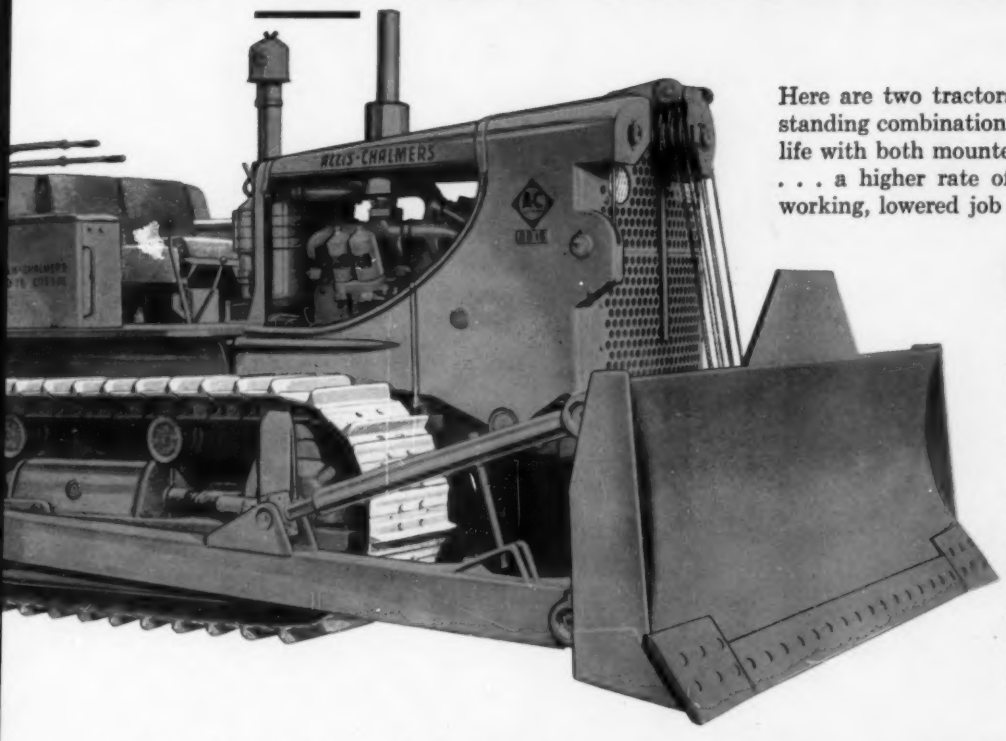

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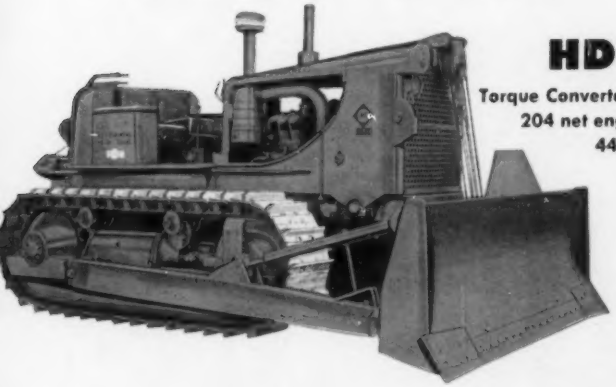

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man, Mr. Payne gained much of the knowledge that led to his part in the founding of Crane Packing Co. He became president in 1917. He was succeeded in the office of Presidency by Karl Rohlen in 1951, at which time he became chairman of the board.

Mr. Payne was a member of the ASME, SAE, Alumni Organization of MIT and Sigma Alpha Epsilon Fraternity.

Engineering Books

Electrical Conductor Technical Manual, prepared by Technical Writing Department of Kaiser Aluminum & Chemical Sales, Inc. Size 8½ by 11 in., 190 pages, illustrated, cloth binding. Available free of charge if requested on company letterhead; otherwise, $2.00 per copy. Copies available from Technical Editor, Kaiser Aluminum & Chemical Sales, Inc., 228 North LaSalle St., Chicago 1, Ill.

This is a practical, comprehensive reference book on aluminum electrical conductor and is designed as a basic guide for use in engineering aluminum conductor installations.

Scope of the book is sufficiently broad to interest all persons actively engaged in the transmission and distribution of electrical power. Utility managers, overhead engineers, purchasing agents, consulting engineers, electrical contractors, and construction personnel will find this book to be of great practical value. An additional feature is approximately 72 pages of industry specifications for ready reference.

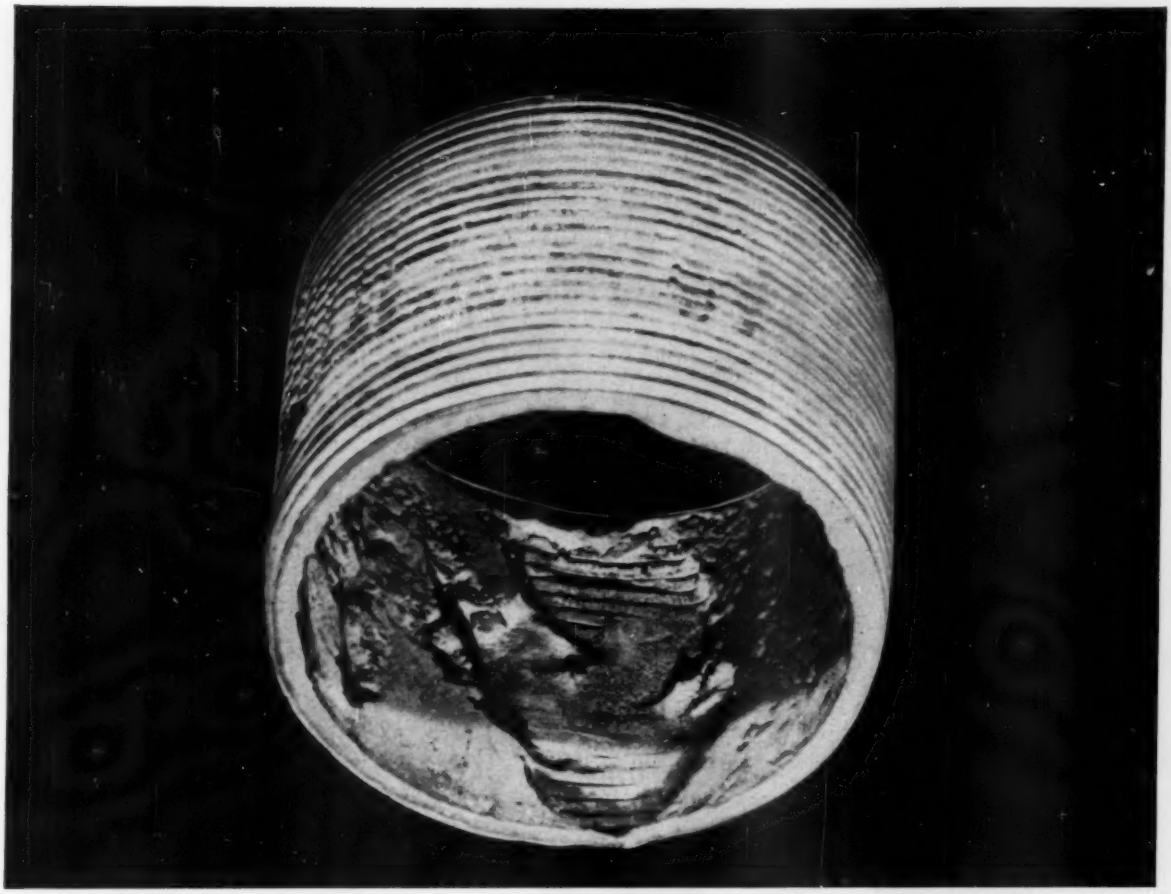
★ ★ ★

Turboblowers by A. J Stepanoff; 377 pages, 6¼ by 9¼ in.; cloth. Published by John Wiley & Sons, Inc., 440 — 4th Avenue, New York 16, New York. 1955. Price $8.00.

Most of us are quite proud of ourselves when we learn to interpret the performance and characteristic curves of pumps, turboblowers, compressors, etc. Our self satisfaction would be a great deal more justified if we were able to sit down and design on paper the pump, blower or compressor which, when fabricated, would fit the performance and characteristic curves, which we really wanted when we started out. This new book is an ambition effort to put more of us in this high strata of engineering acumen, at least in the field of blower design.

Our review of the book shows it to be an expertly written, highly technical, but extremely clear presentation of the theory and practical problems involved in the design, fabrication and operation of turbo compressors.

A measure of the book's excellence can be determined by reading through Chapter 16, "Design of Mixed Flow Impellors", which is one of the most complex aspects of blower design. The author's treatment cannot be



Return line corrosion resulting from carbonic acid

ALL pHOULED UP

pH—a symbol denoting the negative logarithm of the concentration of the hydrogen ion in gram atoms per liter. This scale permits the expression of both acidity and alkalinity in units which can be measured by means of a hydrogen electrode.

That's what chemists say about it. Some of the things that power plant engineers say about it are best left unquoted.

A low pH value in condensate can cause a power plant engineer a lot of trouble. When the pH value of water goes below 6.9, it's becoming acid—and when it's acid, it's highly corrosive. Then it begins to eat away at the internal surfaces of pipes and return lines.

Corrosion caused by low pH is most effectively prevented by the application of Dearborn's FILMEEN.* By forming a non-wettable, monomolecular coating on all metal surfaces with which treated steam or condensate come in contact, FILMEEN provides a protective, corrosion-inhibiting barrier between water and metal. By preventing the carbonic acid from touching the metal surfaces, FILMEEN thus keeps the lines corrosion-free.

When you find rusty condensate coming back to your boilers, it's time to see your Dearborn representative. He'll show you how FILMEEN will reduce excessive maintenance, avoid shutdowns and protect valuable equipment in your power plant.

**FILMEEN—U. S. Pat. No. RE-23614 reserves to Dearborn Chemical Company and its licensees exclusive right to the use of octadecylamine for water treatment.*

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Engineering Books

continued from page 110

said to simplify, but he most certainly clarifies.

The author himself has been a designer and development engineer with the Ingersoll-Rand Company since 1940. He was educated at the University of California (Ph.D. 1930). For thirteen years, before joining Ingersoll-Rand, he was with the Byron-Jackson Company as a designer and assistant chief engineer. He was awarded the Melville Medal by the ASME in 1932. Dr. Stepanoff has also written a book "Centrifugal and Axial Flow Pumps", published by Wiley & Sons in 1948.

* * *

Conveyors and Related Equipment (Third Edition), by Wilbur G. Hudson. Size 6 by 9 in., 524 pages, illustrated, cloth binding. Published by John Wiley & Sons, Inc., 440 Fourth Ave., New York 16, N. Y. Price $9.00.

This new edition of a well known and widely used book on materials handling and related equipment has been expanded by about 25 per cent over the previous edition. New material in the third edition includes: recent developments in belt construction and dynamatic drive control, 1954 costs and designs of silos, bins and bunkers, dust explosion hazards, the hydraulic transportation of coal in pipelines, and other recent engineering advancements in this field.

Many new photographs have been added, while obsolete pictures have been deleted. Typical problems and their solutions have been included.

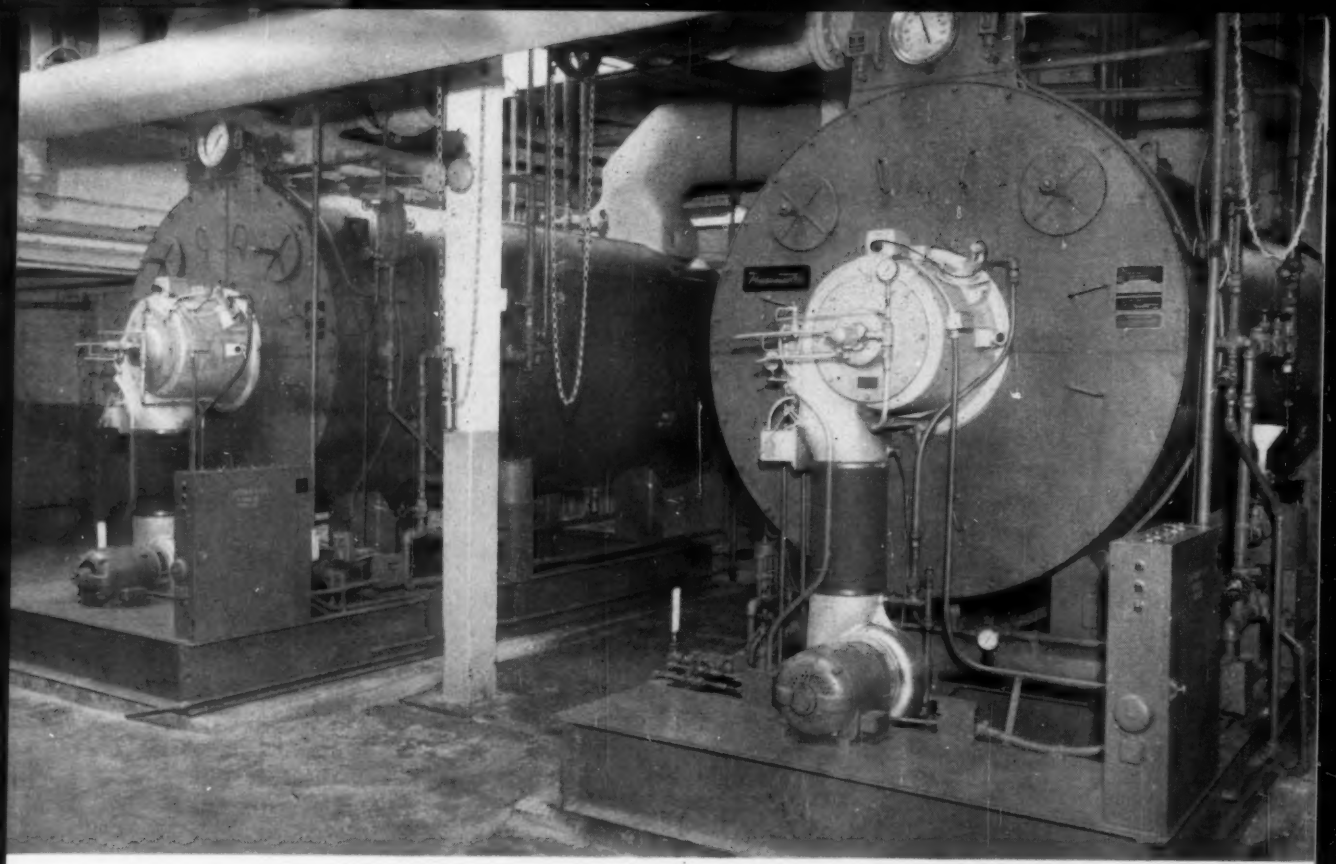
* * *

Electricity: Direct and Alternating Current by Charles S. Siskind, Second Edition. Size 9¼ by 6¼ in., 538 pages, cloth binding. Published by McGraw-Hill Book Company, Inc., 330 W. 42nd St., New York 36, N. Y. Price $5.75.

As the author says in his preface, — this book has a threefold purpose: (1) to present the general elementary principles of direct and alternating current electricity, (2) to show how these principles apply to the construction and operating characteristics of the more common types of circuits, devices, and machines, and (3) to illustrate how these principles may be verified by the performance of simple experiments with easily obtainable and readily constructed apparatus.

The book is intended for use in technical institutes, junior colleges, and short courses for non-electrical-engineering students in universities, as well as in schools conducted by or associated with industry, and in many technical and vocational high schools.

To make the book suitable for use in elementary as well as moderately advanced courses of study, the subject matter was arranged so that instructors can adapt the subject matter to several levels of instruction



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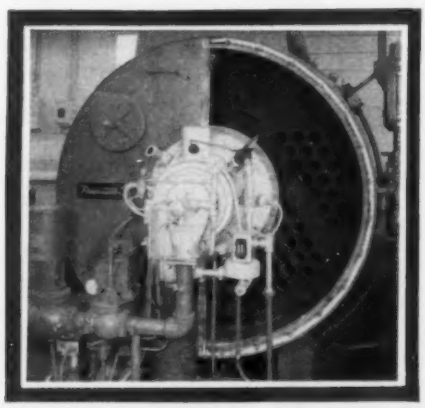

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● Major operating advantages are gained by installing two or more *Powermasters* rather than a single large boiler. These include greater assurance of a constant steam supply, increased flexibility of operation, more efficient light load standby, reserve capacity for extra-heavy load demands and for rapid expansion, greater freedom from downtime for inspection and maintenance.

Sizable cost economies also are effected because of *Powermaster's* simplified installation, space-saving compactness, automatic time-saving operation, fast steaming and quick response to load swings, high fuel economy at all loads, maintenance-saving accessibility and other service-proved features.

These are reasons why multiple *Powermaster* installations are now serving numerous manufacturing industries, institutions, public buildings, schools, housing projects, laundries, military posts and other steam users.

Be sure you take a close look at *Powermaster* advantages whenever you're looking for a dependable, low-cost steam supply for any plant or building requirement. Ask for Bulletin 1220.

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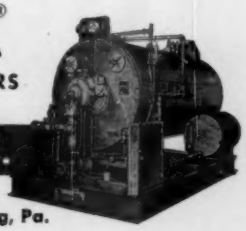
Sizes to 500 hp.; pressures to 250 psi



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How Barco Simplifies Pipe "Expansion" Problems

1. Many new applications! Every day, interesting new uses are being discovered for Barco Flexible Ball Joints in relieving *expansion* and *contraction* in piping — in Power Plants, Steel Mills, Ships, Petroleum and Chemical Processing Plants, and in Central Heating Systems.

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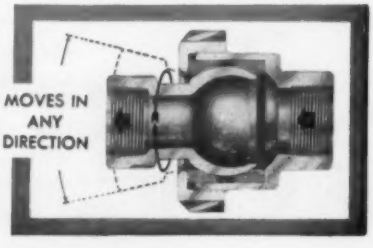

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Engineering Books

continued from page 112

in electricity by including or omitting suitably selected portions of the book.

The book discusses the elementary principles of direct and alternating current electricity. It illustrates how these principles apply to the construction and operating characteristics of the more common circuits, devices, and machines. A series of simple experiments with easily obtained and readily constructed apparatus is presented. From these the student can demonstrate and verify the principles to his own satisfaction and test the practical applications to the topics explained in the text.

Many questions and problems concerning electrical equipment used in practice are given at the end of each chapter, and details are given for the construction of electrical devices which may serve as vocational-training projects where shop facilities are available.

To give the reader an idea of the subjects covered in this book, here is a list of chapter titles:

1. Electricity — Basic Ideas and Effects; 2. Wires and Cables and Their Electrical Properties; 3. Direct-current Circuits 1. — Ohm's Law — Power — Energy; 4. Direct-current Circuits; 11 — Kirchhoff's Laws — Basic Theorems; 5. Alternating-current Electric Circuits and Measurements; 6. Magnetism and Electromagnetism; 7. Direct-current Measuring Instruments; 8. Electromagnetic Induction, Transformer Action, and Transformers; 9. Generators — Direct and Alternating Current; 10. Motors — Direct and Alternating Current.

The book concludes with a list of visual aids that can be used to supplement the material in the book, and an appendix giving brief histories of great men in electrical science and the important electrical developments with which they were associated.

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ELECTRICAL EQUIPMENT

201 Motor-Generator Reference Book — Publication 51R7933 is a 50-pp booklet compiled to assist in the selection of motive power to handle most industrial applications. Neither textbook nor ordering catalog, this book provides a brief outline of the various types of motors, generators and motor-generator sets, telling their applications and operating requirements. Booklet is generously illustrated and includes performance data, ratings, as well as detailed information on methods of speed control. Allis-Chalmers Mfg. Co.

202 Motor Buying Guide — Bulletin GEC-1026, 28-pp, features company's standard a-c fractional and integral horsepower motors in most general use. Included are general- and definite-purpose fhp motors, and fhp gear motors. A section on selection of integral horsepower motors covers horsepower requirements, enclosures, starting current limitations, speeds, motor types, and selection of fuses and circuit breakers. Descriptions and specifications include single-phase, polyphase, totally enclosed fan cooled, and gear-type integral horsepower motors. Ratings, book prices, dimensions, frame numbers are included. General Electric Co.

203 Insulation Temperature-Resistance — Technical Publication 21T4, 16 pp, is an article on temperature-resistance characteristics of electrical insulation. Complete with tables and graphs, gives general information on variations in temperature characteristics, composite nature of electrical insulation, and practicability of temperature compensation. Other chapters deal with determining insulation constants for temperature correction factors, and a practical method of obtaining insulation temperature is outlined and described. James G. Biddle Co.

It's easy to get these free catalogs — just circle item numbers of those wanted on the postcard at right.

204 High-Power Batteries — Bulletin CP-538/55 covers company's line of Hi-Power batteries for use in the control, switchgear, emergency lighting and auxiliary power fields. Includes data on battery ratings and capacities, details of design and construction, dimensions, weights and types of containers. C & D Batteries, Inc.

205 High-Capacity Fuses — Form HCS, 6 pp, describes fuses of unlimited interrupting capacity on voltages to 600, designed to afford protection for loads of 600 to 5000 amp. Includes test data, charts on opening time, current limiting effect. Bussmann Mfg. Co.

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21	22	23	24
25	26	27	28
29	30	31	32
33	34	35	36
37	38	39	40
41	42	43	44

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101	102	103	104	105	106	107
108	109	110	111	112	113	114
115	116	117	118	119	120	121
122	123	124	125	126	127	128
129	130	131	132	133	134	135
136	137	138	139	140	141	142
143	144	145	146	147	148	149
150	151	152	153	154	155	156
157	158	159	160	161	162	163
164	165	166	167	168	169	170
171	172	173	174	175	176	177

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9	10	11	12	115	116	117	118	119	120	121	245	246	247	248	249	250	251	252	253	254	255	256	257	258	259	260	261	262	263	264	265	266
13	14	15	16	122	123	124	125	126	127	128	267	268	269	270	271	272	273	274	275	276	277	278	279	280	281	282	283	284	285	286	287	288
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VALVES, TRAPS, PIPING AND ACCESSORIES

206 Check Valves — Twenty-pp Catalog 30 presents company's line of tilting-disc check valves made in iron, bronze and steel for working pressures to 3000 psi. Explains operating principles of tilting disc construction, discusses closing without slam, reduced loss of head, other advantages. Includes construction details, sizes. The Chapman Valve Mfg. Co.

207 Lubricated Plug Valves — Revised Catalog PV-2, 12 pp, presents steel and semi-steel valves designed to offer quick shut-off of erosive or corrosive fluids. Explains advantages of the lubricated tapered plug design of these valves and pictures single gland, screwed gland, and bolted gland types. Also shows accessories. The William Powell Co.

208 Blow-Off Valves — Bulletin B-426, 20 pp, on blow-off valves for boiler pressures up to 400 lb wsp, contains installation recommendations, construction information on Yarway seatless and double-tightening blow-off valves. Gives full ordering data. Yarnall-Waring Co.

209 General Purpose Valves — Supplement No. 1 to Catalog F-9, 32-pp, offers complete information on company's series of general purpose drop forged steel valves, gate, globe and angle types, sizes ¼ through 2 in. Includes descriptions of each type along with drawings showing component parts. Dimensions and other specifications are tabulated, and a pressure-temperature ratings table is included. Henry Vogt Machine Co.

210 For Precise Control — Fifty-pp Catalog 17 covers manufacturer's line of disc valves and accessories, providing full selection and ordering data, materials of construction, sizes. Describes manual and automatic controls for these valves which, it is noted, are available in any metal which can be cast or welded. Minimum pressure drop, quick closure, simplicity and other advantages are discussed. R. S. Valve Div., S. Morgan Smith Co.

211 Valve Charts — Now available to power engineers are three well-organized wall charts on valve types, selection and protection. "How to know valves" covers four main types of valves from the standpoints of their appearance, inside construction, service intended, operation and use. "How to select valves" discusses five major factors involved in the choice of a valve — fluid, temperature, pressure, size, and function. "How to protect valves" — written in "do and don't" style covers 11 important points in valve installation, operation and maintenance. R-P & C Valve Div., American Chain & Cable Co., Inc.

212 Choosing the Right Valve — Presenting valve selection as a matter of matching the valve's service characteristics with service requirements of the job, this practical 20-pp booklet explains and illustrates basic design features of gate, globe and check valves. It tells, in non-technical language, how each of these valve types works, and where it is suited for use. Disc, stem connection, bonnet and bonnet-joint characteristics are also discussed and the importance of stem operation is treated. Crane Co.

213 Valve Chart — Form 194, 24 pp, is a valve comparison chart, listing valve figure numbers of 15 major manufacturers and the OIC equivalent valve figure num-

DE LAVAL OPPELLER PUMPS

last longer... cut maintenance costs

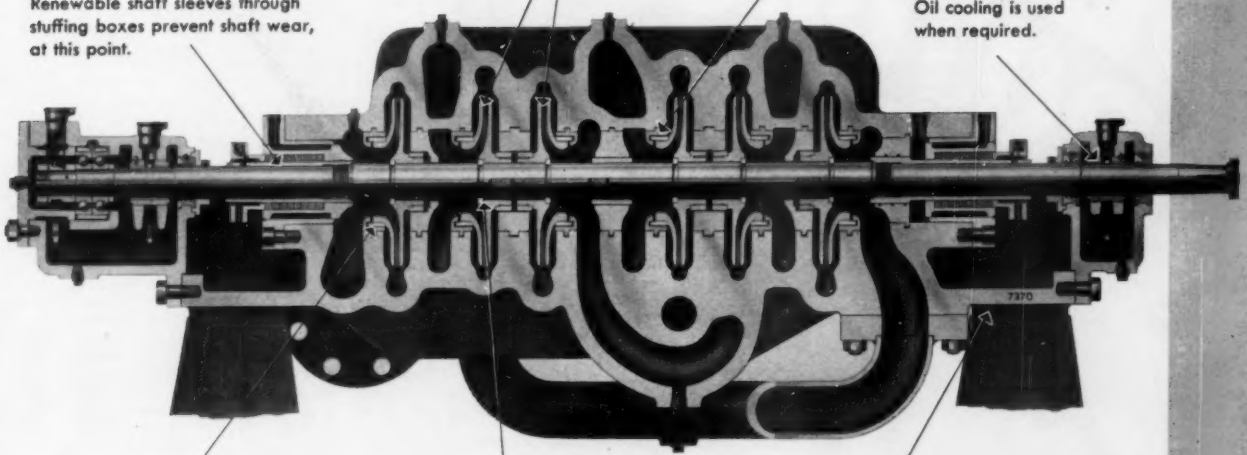
Stages are arranged to reduce differential pressures between stages. This insures permanent sealing at the casing-joint and at interstage diaphragms.

Pairs of back-to-back impellers balance axial thrust. One-purpose thrust bearing carries no radial load, maintains axial alignment.

Labyrinth wearing rings permit safe clearances and reduce wear.

All bearings are ring-oiled, sealed against contamination by water or dust. Oil cooling is used when required.

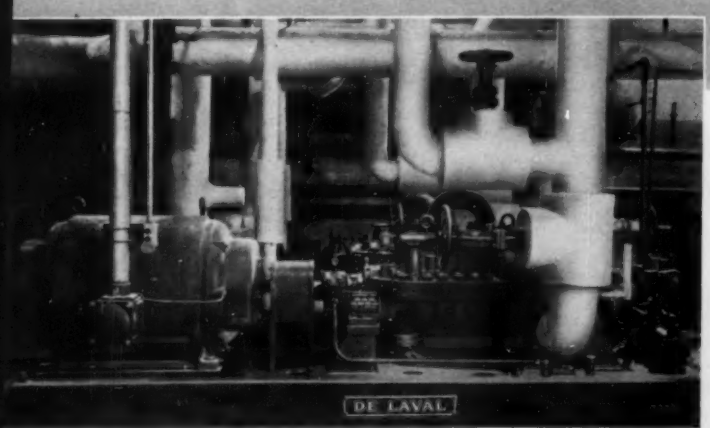
Renewable shaft sleeves through stuffing boxes prevent shaft wear, at this point.



Threaded impeller wearing rings make replacement easy without heating or damage to impellers.

Individual impeller mountings, with split locating rings, make interstage shaft sleeves unnecessary. Impellers can't shift with shaft expansion and contraction.

Casing support insures coupling alignment at any operating temperature.



Here are two De Laval 6-stage Oppeller Pumps used for boiler feed service in an industrial installation.

The design features above show clearly why De Laval Oppeller Pumps stay on the line longer and cost less to maintain. These pumps are used for boiler feed, hydraulic systems, descaling spray, mine dewatering, refinery oil pumping and similar services.

De Laval Oppeller Pumps are available in sizes from 2 to 4 inches and 2 to 8 stages; capacities to 1000 gpm, pressures to 1200 psig and temperatures to 3500F.

DE LAVAL *Oppeller Pumps*

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bers. Compares variety of valves in ferrous and non-ferrous materials, describes different valve lines. The Ohio Injector Co.

214 Steel Gate Valves — Four types of Hancock general purpose steel gate valves for process and power piping systems are described in illustrated Bulletin 202 C, 12 pp. Material specifications, dimensions given, also service pressure ratings. Manning, Maxwell & Moore, Inc.

215 General Service Valves — Bulletin E-160, 16 pp, describes and illustrates design and construction of company's quick-operating valves, explaining their application to blow-off service and on chemical process, soot blowers, water column blow-down, and other types of pipe line. Everlasting Valve Co.

216 Regulating Valves — Bulletin 5305 describes double seated diaphragm regulating valves for use with control instruments, outlining special features of the valves, particularly the "flow line" contoured-body engineered for high capacity at low pressure drop. Leslie Co.

217 Steam Trap Book — Catalog J, 44 pp, serves as a manual of trapping practice. Includes a catalog section giving physical data and prices on cast semi-steel and forged steel inverted bucket steam traps, compound steam traps and ball float air and air relief traps; a handbook section explaining how to calculate condensate loads and select traps for all classes of equipment; a maintenance section explaining trap installation, trouble-shooting and repair. Armstrong Machine Works.

218 Steam Trap Solutions —Bulletin F. 151, 36 pp, is a newly revised edition of this company's well known booklet, "Solving Steam Trap Problems." Organized for easy reference, this illustrated booklet provides specifications and capacities of steam and float traps, air release valves, pipe line strainers. Tells how to calculate condensation loads and select traps for unit heaters, jacketed kettles, submerged surfaces. Gives tips on installing, servicing. The V. D. Anderson Co.

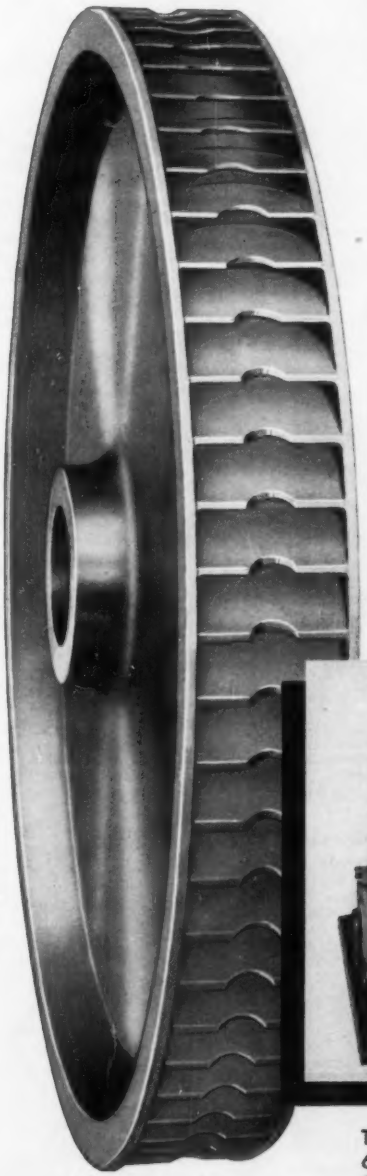
219 Unions and Fittings — Twelve-pp Catalog 50 covers manufacturer's line of unions of all types, elbows, tees and fittings. It describes and illustrates special features. Dart Union Co.

220 Expansion Joints — Rubber expansion joints for relieving strains and stresses in piping, absorbing vibration, and eliminating noise are the subject of 8-pp Form AD-137. General advantages of rubber expansion joints are presented, and spool-type, U-type and rectangular-type joints are described as to construction and intended services. Also provided is catalog sheet on all-Teflon joints and Teflon-lined rubber joints. The Garlock Packing Co.

221 Asbestos-Cement Pipe — Manufacturing methods in producing asbestos-cement pipe for water systems are described in this 8-pp bulletin, which points out savings in installation time and outlines characteristic advantages once the pipe is in the ground. Recommended procedures for installing pipe and assembling Ring-Tite coupling, as well as table of sizes and fittings are included. Johns-Manville.

222 Stainless Steel Pipe Fittings — Bulletin S-3-55 describes company's 150 lb stainless steel pipe fittings for corrosive, high and low temperature service, including 90 deg elbows, tees, 45 deg elbows, crosses, couplings, reducers, pipe caps,

TERRY SOLID-WHEEL *SIMPLICITY* MEANS *SUSTAINED* HP



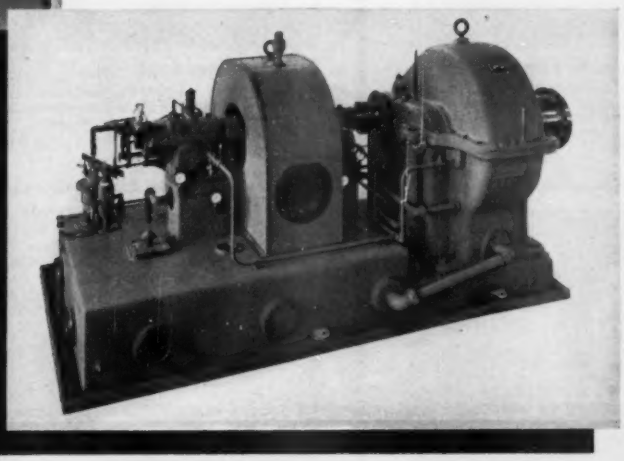
A Terry solid-wheel turbine is simplicity itself. Particularly the rotor. This is a single forging of special composition steel. And, unlike a built-up wheel, has no separate parts to loosen or work out.

Blade wear which might occur after years and years of usage is of little consequence, because the power-producing action of the steam takes place on the curved surfaces at the backs of the buckets. Thus wear does not materially affect horsepower or efficiency.

The blades can't foul. There is a one inch clearance on either side of the wheel and, in addition, the blades are double rim protected. There is no need for close axial blade clearance, because the steam enters the buckets at right angles to the shaft.

Perhaps you, too, can profit from Terry solid-wheel stamina. Bulletin S-116 gives complete details. Send for a copy today.

TERRY STEAM TURBINE COMPANY
TERRY SQUARE, HARTFORD 1, CONNECTICUT



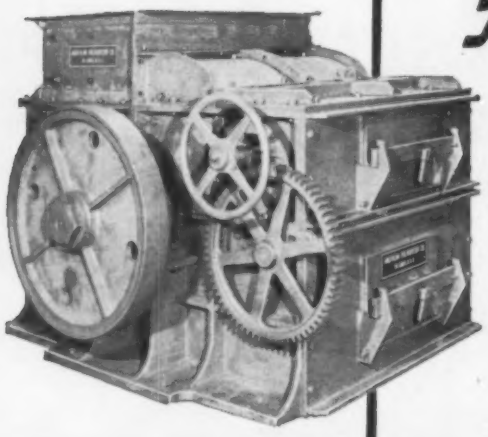
This Terry solid-wheel turbo-geared unit is rated 600 hp, 4000/650 rpm for 820 psi, 825°F steam with 275 psi back pressure.

TERRY

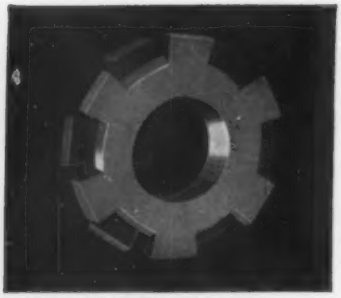
TT-1201

For more data circle 557 on Post Card

BETTER COAL CRUSHING CONTROL BECAUSE IT'S BUILT BETTER . . .

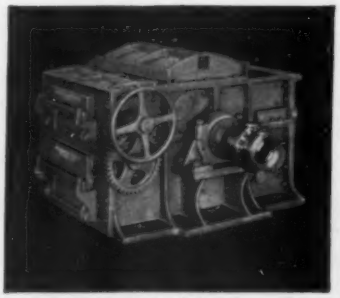


American ROLLING RING COAL CRUSHERS



1 Patented Shredder Ring

American-originated feature that splits coal instead of smashing it—for uniform sizing, minimum fines. Result: Americans run at slow speeds, with savings in power and maintenance. No cams, shear pins, toggles.



2 Heavy-Ribbed Steel Frame

Bearing pedestals are cast integrally with lower side frames. Sectional design for easy dismantling . . . abutting joints accurately machined and bolted together for dust-tight fit.

3 Completely Lined Crushing Chamber

Heavy, renewable liners . . . sectional for easy plate-at-a-time replacement . . . engineered to offer life-time protection to the frame.

4 Complete Accessibility to Adjustment and Parts

All adjustments external—even with crusher in motion. Rotor easily reached by removing top section. Rings readily reversed or replaced. Liners quickly reached, too, for periodical inspection.

WRITE for Coal Crushing Bulletin

American PULVERIZER COMPANY

Originators and Manufacturers of Ring Crushers and Pulverizers

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unions, plugs and bushings. Presents dimensional specifications in sizes ⅛ to 2 in. in both screw end and socket welding types. Applications in chemical plants, refrigeration service, food and other process piping given. Watson-Stillman Fittings Div., H. K. Porter Co., Inc.

223 Seamless Welding Fittings — Alloy, carbon and stainless steel welding fittings are described in 6-pp Bulletin FB-500. Features are discussed briefly and grades and size ranges covered. Photos show fittings and flanges. Tubular Products Div., The Babcock & Wilcox Co.

224 Flexible Ball Joint — Catalog 215-B, 20-pp, describes advantages of company's flexible ball joints for use in piping for power, process, heating, chemical, construction, or hydraulic service. Includes engineering specifications and data on the standard 300 lb series and the series 600. Screwed, flanged and welding end joints are listed, as are insulating joints and jacketed joints for handling asphalt and other liquids that solidify unless heated. Barco Mfg. Co.

PUMPS, COMPRESSORS

225 Boiler Feed Pump — A barrel-type boiler feed pump for high pressure, high temperature service and designed to go on the line quickly without preliminary warm-up is the subject of 12-pp Bulletin 1525. De Laval Steam Turbine Co.

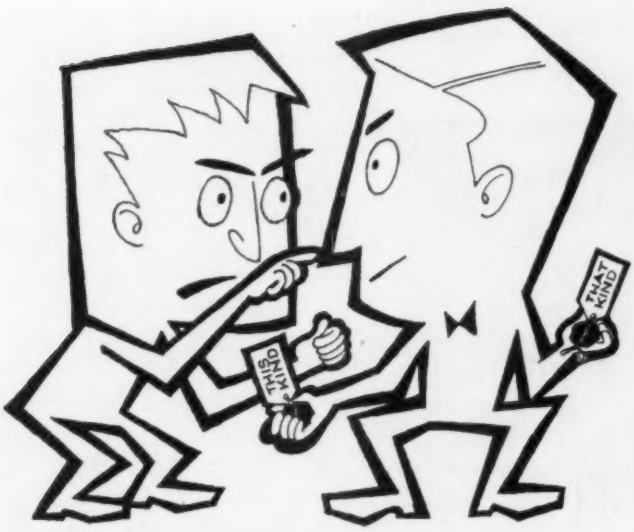
226 On Vertical Pumps — Sixteen-pp Bulletin describes and illustrates application of vertical industrial service pumps for liquid transfer from short settings in both industrial and process services. Points out advantages and describes three basic designs. Stresses versatility of the pumps due to design flexibility. Also gives general recommendations for obtaining optimum performance, and includes photos of typical installations. Peerless Pump Div., Food Machinery and Chemical Corp.

227 Controlled Volume Pumps — Bulletin 953, 24-pp, describes and illustrates use of controlled volume pumps in industrial water treating systems. Construction and operation features are described, capacity-pressure ranges and speed and stroke length adjustments are charted. Typical chemical feed and water treating systems are presented through text and diagrams; and an analysis of boiler water treating systems, cooling water treating problems, and systems for waste and sanitary water treatment included. Milton Roy Co.

228 Balanced Opposed Compressors — Engineering data on company's balanced opposed compressors, 3000 to 10,000 hp (top range in tandem arrangement) is contained in 36-pp Bulletin L-679-B1. Present information on operation, drives, design features, running gear, lubrication, valve action, capacity control, coolers and accessories. A chart listing approximate dimensions is included, along with photos of compressor installations. Worthington Corp.

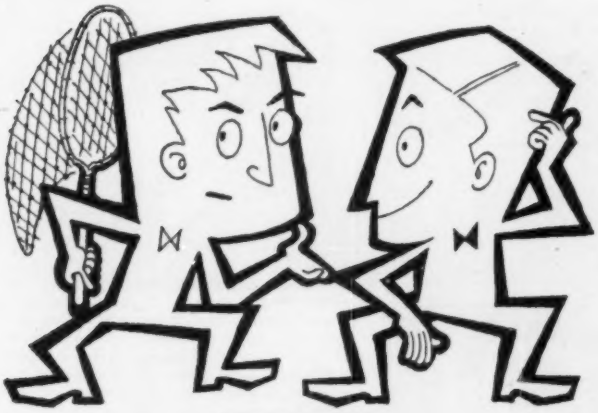
BOILERS, GENERATORS

229 Packaged Boilers — This 16-pp illustrated catalog describes manufacturer's new Type VP package boiler. Following a section of background information is an outline of the principal design features of these boilers, which are shop assembled and provide steam capacities from 4000 to 30,000 lb per hour. Space requirements



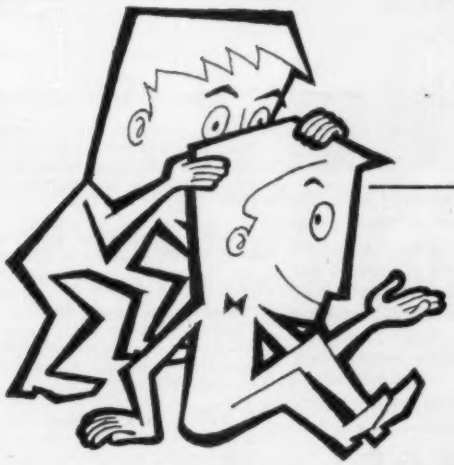
What's the big idea buying several kinds of coal for our steam plants?

It's a good idea. The kind of coal that burns most economically in the old boilers isn't efficient for the new ones.



How do you know you're right?

Look at the coal bills. We are generating more steam at a lower fuel cost. You can tell from the ashes we are getting more complete combustion, and there's less clinkering.



Where did you get this idea, anyway?

From the C & O Coal Department. They convinced us that different types of burning equipment need different types of coal. From the high quality coal produced on the C & O, we selected the quality and size of coal that works best in our particular installations.

P.S.

There's a lot more to buying coal than the cost per million BTU. Why not contact coal producers on the C & O to solve your particular fuel requirements, or write to: R. C. Riedinger, General Coal Traffic Manager, Chesapeake & Ohio Railway Co., Terminal Tower, Cleveland 1, Ohio, for the assistance of a C & O fuel service engineer.

Chesapeake and Ohio Railway

WORLD'S LARGEST CARRIER OF BITUMINOUS COAL

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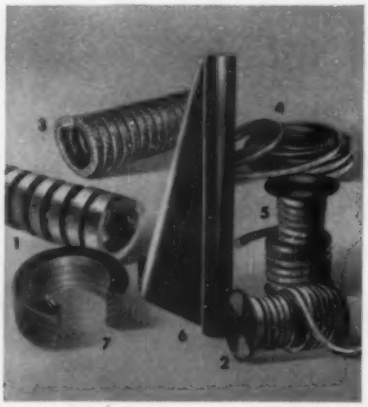
R/M's Big 7 Packing Types will make preventive maintenance easy for you

You can actually set up a schedule of preventive practice with R/M's Big 7 Packing Types. Their custom-built construction will provide you with superlative performance—and lower your maintenance costs and downtime. Most plants find that just 3 or 4 meet all their requirements.

R/M's Big 7 are engineered to give custom-built performance. To assure low friction, for example, the lubricants are ground in during manufacture—not just surface applied. They are locked in so securely that even after wear sets in, the bearing surface remains the same.



See your R/M distributor and find out how easy it is to reduce costs, cut downtime, lower inventories, and simplify ordering by standardizing on the basic, custom-built R/M Big 7 line. All R/M packings for maintenance purposes are sold only through authorized R/M distributors.

Type 1, for pumps, valves; **Type 2,** for high temperature valve stems, expansion joints; **Type 3,** for high speed rotary air compressors; **Type 4,** for corrosives, acids, viscous materials; **Type 5,** "Teflon"* for chemicals; **Type 6,** gasket materials; **Type 7,** for hydraulic and pneumatic equipment.

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are shown in a table along with typical specifications. Also described is control system. Combustion Engineering, Inc.

230 Standard Boilers — Eight-pp Bulletin WT-8 describes company's "S" series of boilers with capacities ranging from 10,800 to 50,000 lb. Lists data and specifications on each of the models and sizes, and discusses general design features and special "S" type construction features. Wm. Bros. Boiler & Mfg. Co.

231 Automatic Boilers — This bulletin describes 17 sizes of Powermaster packaged automatic boilers from 15 through 500 hp for steam process, steam and hot water heating service. Lists such advantages as three-pass design, forced draft and automatic controls. Describes firing equipment for light and heavy oils, gas; shows various fuel firing arrangements. Orr & Sembower, Inc.

232 Improved Steam Generator — Bulletin 2000, 28 pp, explains advance design features that distinguish this manufacturer's generator from other unit steam generators. Describes and illustrates engineering differences of component features. Also shows how these components are constructed, assembled and tested. Another section gives data, and dimensions for the units which range from 20 to 6000 hp. Preferred Utilities Mfg. Corp.

233 Steam Generators — Illustrated Bulletin SB43, 20 pp, describes company's VL factory assembled generators combining 2-drum water-type boiler, integral water cooled furnace, brick work, insulation and steel casing. A large cutaway illustration shows design details, and gas travel. Erie City Iron Works.

234 Steam Generator — This manufacturer's new Type D steam generator, a packaged unit for pressure firing with gas, oils, or combination of fuels, is described in an 8-pp catalog. Gives complete data and dimensions on this water tube generator which is available in 17 sizes with capacities from 8000 to 40,000 lb of steam per hour. Fully illustrated, booklet explains economical steam production. Superior Combustion Industries, Inc.

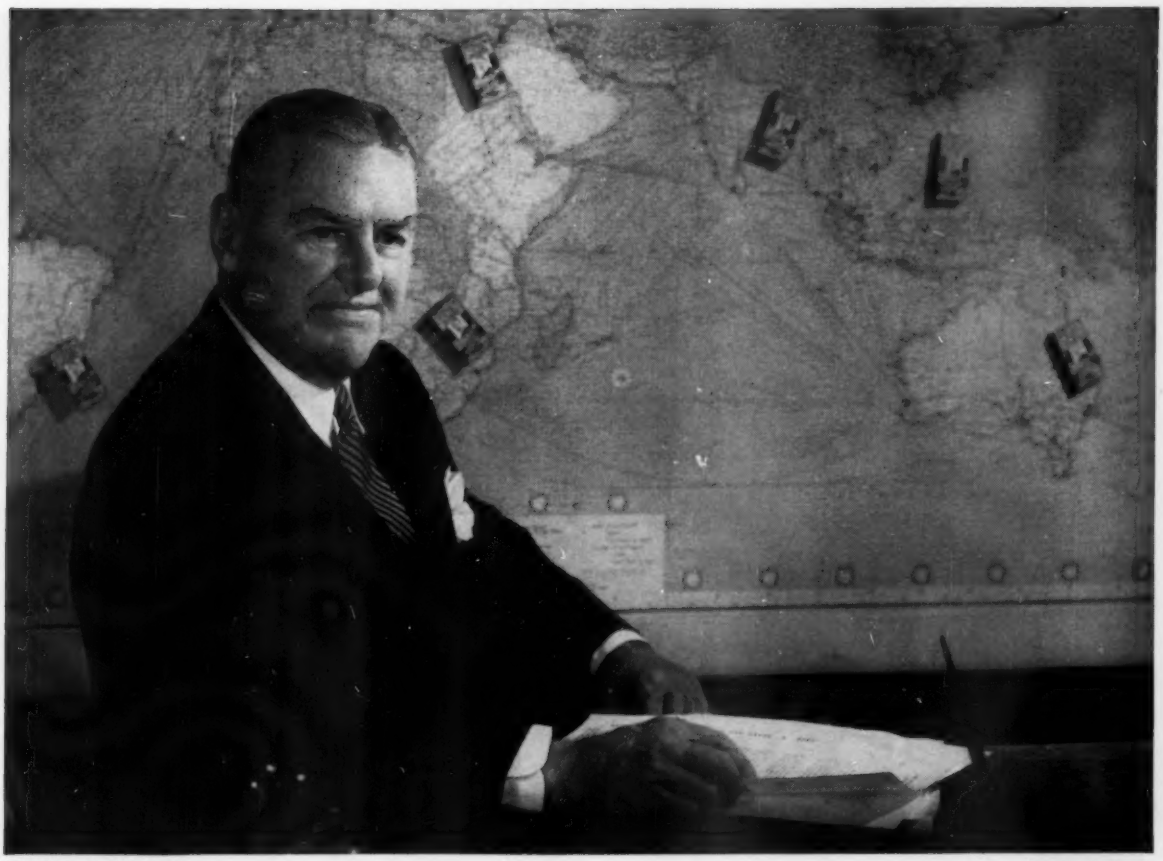
TUBING AND ACCESSORIES

235 Rotary Tube Cleaners — Bulletin R-105 presents air and water driven rotary tube cleaners and cleaner accessories. Illustrates several models and heads. Roto Div., Elliott Co.

236 Nickel Pipe and Tubes — Bulletin T-17 is a 28-pp technical bulletin on the fabrication and design of nickel and high nickel alloy pipe and tubing, illustrated throughout by drawings and photos. Presents tables on mechanical and physical properties, ASME code requirements, recommended welding procedures. The International Nickel Co., Inc.

237 Life Extension for Condenser Tubes — The 32-pp current edition of this booklet reports on research into the causes of corrosion and means of combating them, as well as the choice of condenser tube materials. Points out that Admiralty metal, long a standard for power plant condenser tubes, works satisfactorily in most installations, but other alloys may be necessary in some circumstances. Revere Copper and Brass, Inc.

238 Tube Cleaners — Catalog 76-A provides 48 pp of information on manufacturer's line of tube cleaners. Following



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JOSEPH P. SPANG JR., ***President***
The Gillette Company

If less than 50% of your employees are enrolled in the Payroll Savings Plan . . . if you have not conducted a person-to-person canvass in the past two years *(or if you do not have the Plan)*, act now! Telephone, wire or write to Savings Bonds Division, U. S. Treasury Department, Washington, D. C. You will hear promptly from your State Director, who will be glad to help you conduct a person-to-person canvass that will put an application blank in the hands of every employee. That is all you have to do. Your employees will do the rest. They want to save for their personal security.

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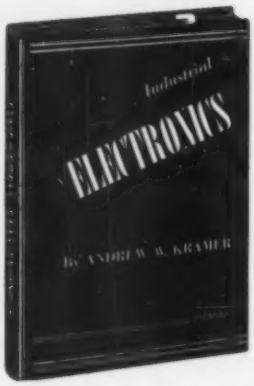

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. . . how they work
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. . . what they can mean to you

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equipment selection and operating hints, this practical catalog describes and pictures cutter heads and drill heads, brushes, and motors, giving sizes, application information. Thomas C. Wilson, Inc.

COAL HANDLING

239 Burning Bituminous Coal — This 24-pp illustrated booklet is a compilation of numerous actual case histories of industrial plants and institutions which burn bituminous coal "the modern way." Stressing operating economy achieved, these case histories show problems overcome, equipment used, and savings realized. Bituminous Coal Institute.

240 Spreader Stoker — Sixteen-pp Bulletin 800 describes manufacturer's Type C-C RotoStoker, a relatively small spreader stoker offering continuous cleaning and ash discharge advantages of larger units, without need of a basement for ash-removal. Explains this and other operational advantages of the stoker, which is adapted to modern steam boilers with output capacities of about 5000 to 75,000 lbs of steam per hour. Detroit Stoker Co.

Postage-free cards for ordering catalogs are on page 115. You may also use the cards to order literature mentioned in the ads.

241 Coal Crusher — Company's WC and WS series rolling ring coal crushers are described in Bulletin 154. Emphasizes special construction elements that mean greater coal reduction at lower operating costs. Cross section illustration shows both feeding and crushing action incorporated and tables give capacities, speeds, and dimensions. American Pulverizer Co.

242 Tractor Shovel — The engineering, design and production stories of company's HD-11G tractor shovel are pictorially presented in 8-pp Catalog MS-460. Includes specifications and describes various features which mean easier servicing for less time-down in the field, greater operator comfort. Allis-Chalmers Mfg. Co.

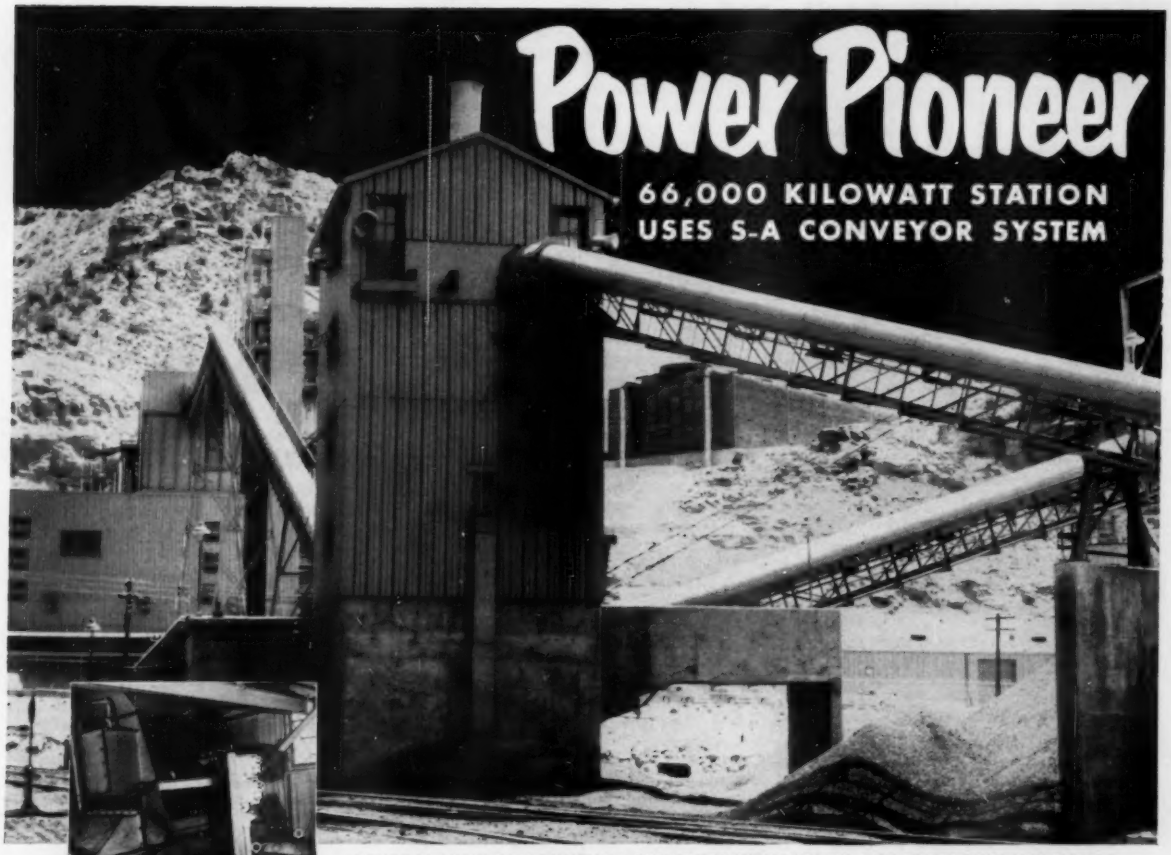
WATER CONDITIONING

243 What's What on Ion Exchangers — Here are three booklets on ion exchangers: Nalcite HCR, a styrene type cation exchanger; Nalcite SAR, a strongly basic anion exchanger; and Super Nalcolite, a synthetic gel type zeolite for cation exchange. Tables and graphs explain performance of these water treating resins under various operating conditions. Physical characteristics, exchange capacities, regeneration techniques discussed. Bulletin 57, 20 pp, is on Nalcite SAR; Bulletin 58, 28 pp, Nalcite HCR; Bulletin 59, Super Nalcolite. National Aluminate Corp.

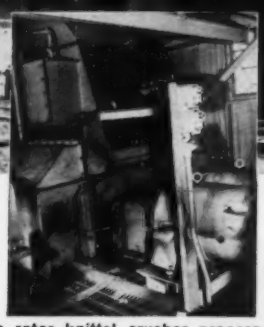
244 Handbook on Demineralizing — Comprehensive 40-pp Bulletin 5800-B compares various methods of water treatment, indicating the comparison between demineralizers and evaporators. It discusses the characteristics of the various types of available cation and anion exchange materials and offers data on operating costs of demineralizing. It tells when to use 2-bed, 3-bed, 4-bed, mixed or monobed demineralizers. It also indicates when decarbonators or vacuum deaerators should be installed. Cochrane Corp.

Power Pioneer

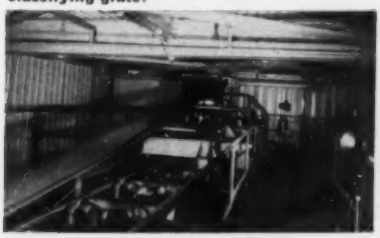
66,000 KILOWATT STATION USES S-A CONVEYOR SYSTEM



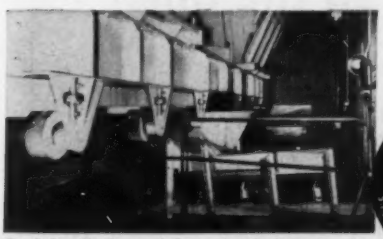
GENERAL VIEW OF CONVEYOR GALLERIES RUNNING TO AND FROM CRUSHER HOUSE



Double rotor knittel crusher processes 200 tons per hr. Coal is broken up by rotating twin sector gangs and dropped through size classifying grate.



Traveling tripper discharges 24 inch conveyor belt at any point into coal bunkers at either side of conveyor. Tripper covers a 55 ft. run.



Coal is discharged from track hoppers by twin S-A reciprocating plate feeders. Coal is moved underground at a rate of 200 tons per hour. Feeders are 40 in. wide by 14 ft. long.

The first steam-electric station to serve advancing power demands in the area, this Utah Power and Light Company plant depends for coal delivery on a conveyor system built and engineered by Stephens-Adamson. Tremendously rich in coal and other mineral deposits, the barren country around Price, Utah is destined to serve one of the nation's future great industrial centers.

As usual, S-A custom designing has been instrumental in effecting initial cost savings. Routine maintenance has been made easy by "in the open" construction.

Coal handling problems get swift and expert treatment by S-A engineers. They are capable of complete plant layout or are available to work in cooperation with your plant engineer.

More than half a century of designing and manufacturing experience is why it will pay you to convey the S-A way. We know how to move bulk materials at lowest possible cost per ton. From our very complete line of manufactured products we can supply the smallest or largest requirements.

STEPHENS-ADAMSON MFG. CO.

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Designers and manufacturers of all types of bulk materials conveying systems.

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A complete line of conveyor accessories—centrifugal loaders—car pullers—bin level controls, etc.

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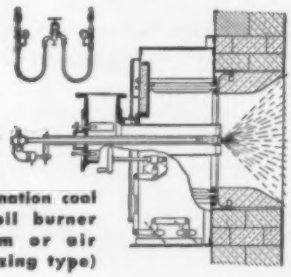
7 ADVANTAGES

in pulverized coal fired boilers . . .

They may be installed in practically all types of pulverized coal burners, with these seven important advantages:

- **They warm up cold furnaces**
- **They ignite pulverized coal—safely**
- **They assure continuous operation in case coal system fails**
- **They provide efficient and safe operation on bank and at low loads**
- **They respond almost instantly to sudden load changes**
- **They permit operation with oil or coal—whichever is available and lowest in cost per BTU.**
- **All capacities of steam, air or mechanical-atomizing types are interchangeable**

The foregoing are only a few of the reasons why Enco oil-burners have been bought by a long list of leading industrial firms. Details of how Enco oil-burners can be adapted to your present pulverized coal burners will be gladly supplied—without obligation. Write The Engineer Company, 75 West St., New York, N. Y.



Combination coal and oil burner (Steam or air atomizing type)

Combination coal and oil burner (Mechanical atomizing type)

Enco Burners

For more data circle 563 on Post Card

245 Feedwater Treating — Bulletin 1855, 30 pp features manufacturer's hot process Accelerator for treatment of boiler feedwater, illustrating and explaining its operation and advantages, also optional equipment. Contains excellent discussion of necessity for treatment of makeup water, selection of proper equipment. Also covers the limitations of hot process softening. Infilco Inc.

246 Steam System Treatment — This bulletin on Coravol for prevention of corrosion explains theory of corrosion, application of organic amines to steam systems (Coravol process) and presents case histories of use in different types of plants and industries. Coravol is part of a complete technical service providing chemical formulas for treatment of water, steam, brine, fuel. Western Chemical Co.

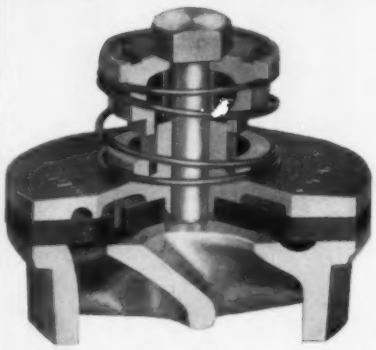
247 On Cooling Tower Wood — The protection of cooling tower wood is the subject of Technical Paper 130. Explains how chemical and bacteriological attack can be controlled by acid treatment and wood preservatives to kill fungi. W. H. & L. D. Betz.

248 Water Treatment — Bulletin 5000, 24 pp, explains the reasons for boiler water treatment and tells services offered by company in providing formulations for individual plant requirements. Covers pretreatment, internal treatment, treatment application, blow-down adjustment, test control. Dearborn Chemical Co.

249 Demineralizers — Valuable information on demineralization is offered power engineers in comprehensive 24-pp Bulletin WC-111. Discusses demineralization in general and its advantages and applications. Basic types of demineralizers and their special uses are charted. Resins, piping, valves and accessory equipment are treated in detail. Book also provides flow charts showing demineralization systems for chemical plants and power plants. Graver Water Conditioning Co.

250 pH and Chlorine Control — The 12th edition of company's handbook "Modern pH and Chlorine Control," 100-pp, incorporating theory and practice of colorimetric analysis, serves as a reference for quantitative determination of pH, chlorine, phosphate, nitrite, sulfate, hardness and other tests. Slide comparators and complete test kits are illustrated. In addition to standard pH determinations, methods are outlined for quantitative analyses of phosphate, calcium, magnesium, silica nitrate hardness in feedwater. Available to qualified power engineers. W. A. Taylor Co.

SIMS INCLINED PORT ROTATING PUMP VALVES



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1. **REDUCE Seat and Disc Wear.**
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3. **REDUCE Maintenance Costs.**
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Sims Valves are available for all reciprocating pumps from stock.

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Sims PUMP VALVE CO., INC.

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DO YOU WANT AN ENGINEERING JOB WITH A FUTURE?

The Ohio Valley Electric Corporation, a new Company operating two large steam generating plants in the Ohio Valley has opportunities now for TEST (efficiency), METER, RELAY, and COMMUNICATIONS Engineers. If you have an engineering degree and are interested in a fine opportunity, write Personnel Director, Box 468, Chillicothe, Ohio.

It's going on all the time!

Foreign solids accumulate in boilers continuously. If you would hold the concentration within suitable limits it follows that removal must also be continuous. You cannot expect to maintain efficient trouble-free steaming by blowing now and then; but too often you can expect to upset the load balance and waste a lot of heat units as well as money down the drain. Why not learn about the modern way to blow boilers, save trouble, save money and avoid stress upon equipment; write for catalog on "Correct Blow-Off" to *The Madden Corp., 1543 W. Morse Ave., Chicago 26, Illinois.*

For more data circle 565 on Post Card

251 Corrosion Treatment — "Corrosion Protection of Steam and Condensate Return Systems" is a folder on amine treatment for boiler and condensate systems. This treatment is described as affording surface protection of the metal as well as raising pH value of condensate. The Bird-Archer Co.

252 For Industrial Water Softening — Greensand, zeolite and resinous exchange water softeners are described in 8-pp Form S-105. Discusses features and applications of each of these basic types and illustrates some installations. Includes capacity data and general specifications. Also describes and pictures controls for water softeners, pressure filters and deionizers. Illinois Water Treatment Co.

253 For Water Wells — An acidizing service for water wells, designed to increase water yield by enlarging formation channels and by removing scale deposits from pumps and screens is described in this folder. Lists advantages of this service, and cites some case histories. Dowell Inc.

INSTRUMENTS AND CONTROLS

255 Metering and Control Equipment — Sixteen-pp Bulletin 18 is a comprehensive catalog offering information on company's meters, control equipment and engineering services. It is written for engineers in power plants, public utilities and process plants. Fifteen measured variables common to power and process operations form the index for selecting appropriate equipment. Bailey Meter Co.

256 Boiler Feed Control — Bulletin 1003, a 12-pp catalog on boiler feed regulators, is illustrated with large application photos and detailed schematic drawings and charts. Relay and direct operation are covered. Case studies of representative boiler loads are presented to show stability of the Flowmatics in controlling feedwater automatically. Copes-Vulcan Div., Continental Foundry & Machine Co.

257 Electronic Flow Meters — Publication 55-1074-222, 12-pp, describes company's line of electronic flow meters for measurement of differential pressures, liquid level, fluid, gas, air or steam flow, temperatures and pressures. Points out advantages, describes mercury-less transmitters, transmission system, receiver, integrator, other features. The Hays Corp.

258 Indicating Flow Meter — Bulletin 18-A, 22-pp, discusses advantages, construction and operation of company's Type H indicating flow meter. Presents technical data on the principles and theory of fluid measurement and discusses orifice type meters and orifice meter principles. Offers examples of flow rate calculations. Schematic drawings and diagrams, tabulated technical data and specifications are included. The Meriam Instrument Co.

259 Bi-Color Gage — Bulletin 1174 gives advantages of company's Multi-Port bi-color gage made for boiler operating pressures to 3000 psi. Points out chief design features, illustrates construction details through photos and drawings. Installation methods are also treated. Diamond Power Specialty Corp.

260 Sampling System — A newly developed system for continuous sampling and oxygen measurement of combustion processes is described in Bulletin 703. Points out advantages of system and diagrams component parts. Selection of sampling tube and gas selector units is discussed. Arnold O. Beckman, Inc.

261 Easy Reading Gage — An all-hydrostatic remote reading gage for boiler water and other liquid levels is described in Catalog 500, Section CO. Pictures improved visibility, other advantages offered by this gage, explains operation. The Reliance Gauge Column Co.

262 D-C Amplifier — Twelve-pp Bulletin MSP 111.1 provides pictorial diagrams and descriptive information on company's PowrAmp Model P, an electronic low-voltage linear amplifier designed to increase the speed and accuracy of low level d-c voltage measurements. Discusses performance and construction features of the amplifier, and describes some applications. Specifications and ordering suggestions given. Hagan Corp.

BURNERS

263 Automatic Burner — Bulletin 420 contains approximately 30 pp of engineering data on a new burner unit for gas, oil or combination firing and sized for capacities to 42,000 lb of steam per hour. Separate sections of this looseleaf manual are devoted to photos and discussion of special features of the burner, general specifications, parts list, wiring and piping diagrams, explanation of operating sequence, and performance data. Available to qualified power engineers, please state your job title when requesting this bulletin. Peabody Engineering Corp.

264 Oil and Gas Burners — Bulletin OB-53, 28 pp, gives principles of selection and application of oil or gas burners, or a combination of both for standard and wide capacity range operation, together

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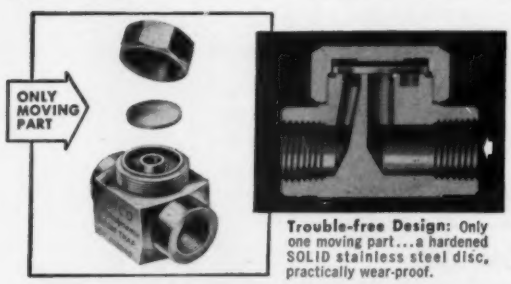

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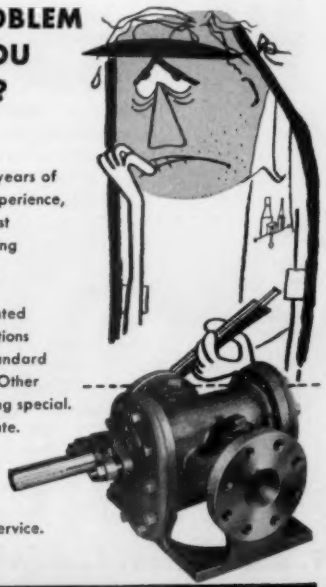

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with air registers and fuel oil heating and pumping sets. Conversion table shows approximate relationships between quantity of oil burned, boiler capacity and air required for combustion. The Engineer Co.

265 Steam Atomizing Oil Burners — Sixteen-pp illustrated Bulletin 21 describes steam atomizing oil burners and auxiliary equipment for use with heavy oil or tar in boilers, stills, dryers and other furnaces, where steam or compressed air is available for atomizing the oil. Includes information on furnace design and construction. National Airoil Burner Co., Inc.

OTHER EQUIPMENT

266 Steam Accumulator — How the steam supply and demand can be balanced by means of company's steam accumulator is told in Bulletin RA-52-8. Stresses reduced boiler capacity required and increased boiler efficiency afforded by use of the accumulator, other advantages. Discusses operating principle, tells how to figure capacity. Foster Wheeler Corp.

Bulletins reviewed here are offered primarily for qualified power engineers. Manufacturers may withhold literature from persons who do not state their job title and company. Some manufacturers also prefer not to send literature to those in foreign countries in which they have no sales representatives.

267 Fluid Drives — Bulletins 9419 and 9519 are an illustrated catalog and selection guide on company's new Type VS Class 2 Gyrol fluid drives. Catalog discusses advantages and applications of the drives, covering speed control, power savings, simplified installation, etc. A sectional view shows construction and principle of operation. Dimensions for six sizes of drives are provided. Selection guide consists of tables indicating proper drive to use with motors from 7.5 to 800 hp. Separate tables cover variable and constant torque loads. American Blower Corp.

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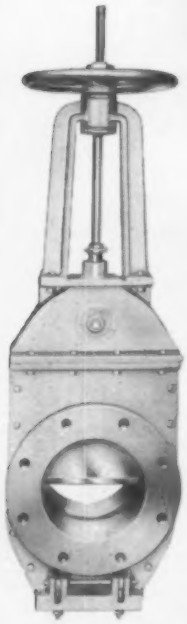

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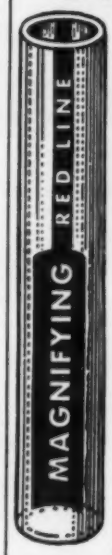

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268 Corrosion, Abrasion Control — Modern practices and products for the positive protection of metal equipment from the effects of corrosion and abrasion are described in this 16-pp bulletin. Covers factory and field application of rubber or synthetic linings to metal parts or products, and maintenance coatings available for application by plant personnel. Goodall Rubber Co.

269 Speed Reducers — Design and operation advantages of company's line of Torque-Arm speed reducers are outlined in 28-pp Bulletin A-637. Includes selection tables for double and single reduction units, bore dimensions and bushings, data on overload releases, flange mounted speed reducers, and recommended V-belt drives. Dodge Mfg. Corp.

270 Tubing Support System — Twelve-pp Bulletin 254 presents a system for permanent and continuous support of instrument tubing. All items and fittings are illustrated by photo or dimensional drawing. Details of actual installations show some of the methods by which this system can be quickly and economically erected at the job site. Instrof Inc.

272 Bearing Lubrication — Vol. XL, No. 10 of this company's Lubrication magazine provides an excellent 12-pp article on industrial bearing lubrication. Illustrated with photos and drawings, text covers such subjects as bearing design; bearing surfaces; bearing overhaul; aspects of lubrication, including factors involved in choice of turbine oils and diesel lubricants, effects of moisture. The Texas Co.

273 Corrosion Control — Treatment of industrial equipment to control corrosion cannot be a hit-and-miss proposition, cautions this 6-pp folder. Examples are given of optimum control measures that may avoid costly, unsound treatment procedures, including minor physical or operating changes. Hall Laboratories, Inc.

274 Packings and Gaskets — Catalog P-100C, 32 pp, covers 95 most popular packings and gaskets in company's line, furnishing details of construction, service recommendations and size information. Includes charts showing applications. Packing Div., Raybestos-Manhattan, Inc.

275 Preheating Combustion Air — This well-illustrated 36-pp booklet explains fuel savings and increased performance made possible by using waste heat in flue gases to preheat incoming combustion air. Also covers increased boiler output, ability to use lower grade fuels, other advantages afforded. Booklet contrasts regenerative with recuperative preheaters; explains operating principle and structural details of the Ljungstrom air preheater. Applications for other than power boilers are also covered. Air Preheater Corp.

276 Heat Transfer Apparatus — Condensed Bulletin HT-1 highlights representative products in company's line of heat transfer equipment. Includes oil heaters and coolers, strainers, evaporators, heat exchangers, radiafin air coolers, tubes, pipes, and coils. Cross-section views of typical units are shown, brief descriptions given, and references to other bulletins are listed. Schutte and Koerting Co.

277 Steam Turbines — The advantages of company's solid wheel turbines, axial flow turbines, single stage and multistage, are outlined in illustrated Bulletin S-140. Describes various models in their line and includes application photos. The Terry Steam Co.

278 Belt Conveyor Carriers — Carriers designed for rugged jobs, exposure to dust and long service are the subject of illustrated Bulletin 453. Shows how their spun end rolls and welded steel frame contribute to extra strength and better balance. Stephens-Adamson Mfg. Co.

279 Turbine Speed Control — Thirty-pp wire-bound Bulletin H-21 is titled, "Fundamentals of Turbine Speed Control." It is an elaborately illustrated, educational booklet intended to clarify the operation of common types of automatic speed control for steam turbines. An introductory section covers general fundamentals of automatic control systems, and includes a key to control terminology. Simplified diagrams show operating principles of actual control systems. Elliott Co.

280 Steam Condensers — Some recent additions to this company's power plant condenser installations are pictured and described briefly in this 24-pp booklet. Also included are an engineering section on condenser design factors, and sections devoted to air removal equipment, to steam condenser specialties, and to maintenance services available. Condenser Service & Engineering Co., Inc.

281 Sheet and Plate Fabrication — Illustrated in 40-pp Bulletin F-3 are products of this manufacturer, and equipment used to produce special sheet steel and alloy parts. Shows control panels, switch gear housings, cubicles and other electrical enclosures, boiler air ducts, smoke breechings, tanks. The Kirk & Blum Mfg. Co.

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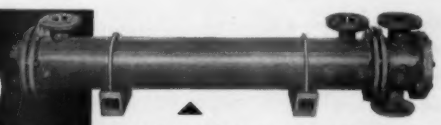

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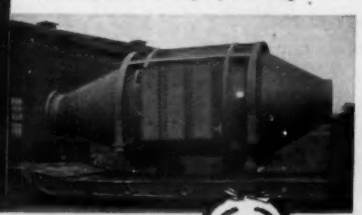

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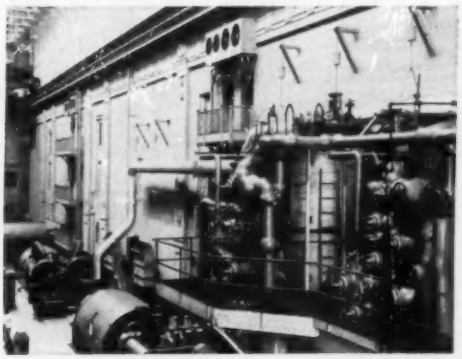
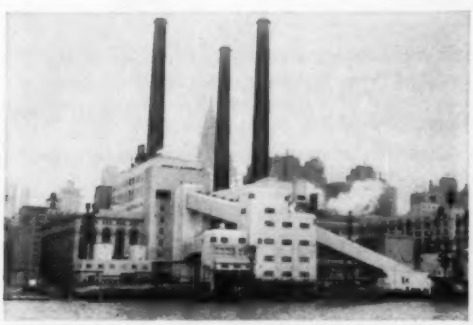
ILLCO-WAY MIXED-BED DE-IONIZERS REDUCE SILICA TO .01 PPM IN MAXIMUM MAKE-UP OF 2,500,000#/HR.



Above, a view of part of the completed ILLCO-WAY Automatic Mixed-Bed De-Ionizer installation at Consolidated Edison Waterside Station, New York City, showing how the ionXchange tanks are ranged along one wall of the turbine room.



CONSOLIDATED EDISON WATERSIDE STATION, N. Y.

This big plant is not only a 100% high-pressure station but, because of large steam sales for skyscraper heating, it has a maximum potential make-up requirement of as much as 2,500,000 lbs. per hour. Water supply and operating conditions were causing the silica concentration in the boiler waters to be of the order of 30 to 35 ppm, resulting in excessive fouling and serious losses. To solve this problem, an automatic mixed-bed de-ionizer system was chosen, after thoughtful analysis and a period of careful pilot-plant tests. The installation has brought the silica in make-up water down to only .01 ppm.

The Mixed-Bed De-Ionizer is one of the most remarkable pieces of water-treating equipment to be introduced since the advent of practical ionXchange. In this system, both anion *and* cation exchange resins are contained in *one* tank, and remain thoroughly intermixed during the service cycle. The result is that the water receives a great number of first cation and then anion exchanges—the equivalent of an enormous number of separate exchange tanks in series. The effluent thus is much more thoroughly "purified" than in the usual single pair of exchangers.

SYSTEM HAS MANY ADVANTAGES

This Mixed-Bed system, which has now been developed into practical form, is particularly effective in the reduction of silica—which makes it of great interest to power plant operators, especially those with high-pressure boilers. In several recent installations, Mixed-Bed ionXchange equipment has proved to be more effective and much more economical than any of the other methods considered. It is also very compact, and requires a minimum of service and maintenance. Operation, after initial tests, is easily established, uniform, reliable, and understandable. Our representatives are equipped to discuss all the possibilities with you, and to make such recommendations as may be justified.

ILLCO-WAY

NEW YORK OFFICE:
141 E. 44th ST., NEW YORK 17, N.Y.

CANADIAN DIST.:
PUMPS & SOFTENERS, LTD.,
LONDON, ONT.

ionXchange

ILLINOIS WATER TREATMENT CO.

840 CEDAR ST., ROCKFORD, ILL.

For more data circle 573 on Post Card

America has homework to do!

THERE'S PROBABLY a lot about your town that makes you want to brag a bit about it.

But there's one thing you *can't* be proud of. And it's a shame you share with just about every other community in America.

The homes where far too many people live are a disgrace. Slums, semi-slums, housing blight are with you. Fixing them up is the homework to be done.

If your town is like most in the U. S., here's what the figures show: 1 out of every 10 homes are rock-bottom slums. Nearly one-half urgently need basic repairs.

But slums are something that is happening on the other side of town, you may say. The problem isn't mine.

Slums are YOUR homework

Distance is no barrier against the threat and cost of housing blight.

Your taxes go up because it takes more money for your town to fight the diseases and delinquency and poverty spawned in the slums. The security of your family goes down because the slum is the natural parent of crime.

Where your business comes in

Every firm has a responsibility toward the town where it's located. Part of it is to support community improvements as any other good citizen would.

Some slums are beyond repair. They must be torn down and a fresh start made. Others can be made to conform to accepted living standards. So it is up to you to get behind every sound program which seeks to provide adequate housing for all our people.

Civic and individual groups must have business backing . . . *your* firm's backing if they are to succeed.

Follow the course of Action!

A group of Americans from every walk of life has joined together in a non-profit organization to combat home and community deterioration, A.C.T.I.O.N., the American Council To Improve Our Neighborhoods.

Send today for a free copy of "ACTION." It explains what A.C.T.I.O.N. is and proposes to do. It lists booklets, research, check-lists, and other material which can help you. Address P. O. Box 500, Radio City Station, New York 20, N. Y.

ACTION

American Council To Improve Our Neighborhoods

Only Chapman Tilting Disc Check Valves give you

FAST TIGHT QUIET CLOSURE

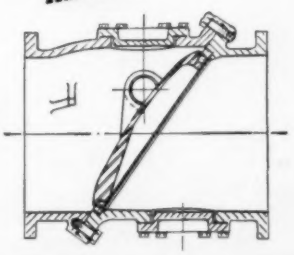
Fast, quiet operation means low cost operation for check valves. That's exactly what the Chapman Tilting Disc Check Valve is designed to do. It won't flutter or slam and damage the piping joints or the valve itself. The unique drop-tight closure action eliminates scraping and wear of the disc and seat.

Rugged construction and low wear of the Chapman Tilting Disc Check Valves mean long life under severe operating conditions. Absence of vibration plus low head loss keep maintenance of the entire piping system at a minimum.

Whether for replacement or for new piping systems, be sure to specify Chapman Tilting Disc Check Valves. They're available in iron and steel for handling fluids or gases under a wide range of pressures. For full data on the complete line, write today. Ask for Catalog 30-A.

The Chapman Valve Mfg. Co.
INDIAN ORCHARD, MASSACHUSETTS

Here's why Chapman's Tilting Disc Check Valves Keep Quiet All of Their Lives



This specially designed "airfoil" disc balances perfectly in open position. The fluid holds the disc tightly against its stops without flutter. The body of the valve is larger around the disc, so the net valve area is at least as much as the pipe area to assure low flow resistance.

When the flow is reversed, pressure against the upper part of the disc cushions it as it closes. Then the disc drops easily and tightly to its beveled seat after the valve has swung closed. Seating is fast and quiet with minimum head loss in all but unusual piping arrangements.

For more data circle 575 on Post Card

DUKE POWER Company turbines at Riverbend Steam Station, Mt. Holly, North Carolina. All seven turbines in this plant, with a capacity of 631,000 kw., are lubricated with *Texaco Regal Oil R&O*. In addition, four turbines, totaling 210,000 kw. capacity, at Duke's Cliffside Steam Station, Cliffside, North Carolina, and six turbines, totaling 440,000 kw. capacity, at Buck Steam Station, Spencer, North Carolina, are also 100% Texaco-lubricated.

NO SLUDGE, NO RUST, NO FOAM IN DUKE TURBINES...

THE REASON WHY: Seventeen of Duke Power Company's steam turbines — having a total capacity of more than 1,281,000 kw. — are lubricated exclusively with world-famous *Texaco Regal Oil* — the oil that, throughout its extra long service life, affords extra protection against sludge, rust and foam, assures clean turbine systems, normal bearing temperatures, instantaneous governor response.

Texaco Regal Oil R&O is made from carefully selected choice base stocks. These are specially refined, then further improved by effective additives and special processing.

There is a complete line of *Texaco Regal Oils R&O* to meet the stringent requirements of all leading turbine builders, for all types and sizes of turbines.

Let a Texaco Lubrication Engineer help you achieve greater power plant efficiency. Just call the nearest of the more than 2,000 Texaco Distributing Plants in the 48 States, or write:

The Texas Company, 135 East 42nd Street, New York 17, N. Y.

TEXACO

TEXACO Regal Oils R&O

FOR ALL TURBINES

TUNE IN: TEXACO STAR THEATER starring JIMMY DURANTE on TV Sat. nights. METROPOLITAN OPERA radio broadcasts Sat. afternoons.

For more data circle 576 on Post Card